AIR CONDITIONING HEATING AND VENTILATING

JUNE 1959

For the Engineer
Engaged in DESIGN
APPLICATION
ESTIMATING
SPECIFICATION
and LAYOUT

IN THIS ISSUE

Time-Saving Procedure for Pipe Stress Analysis 81

Office Output Upped Over 9% by Air Conditioning .. 67

Cutting Ventilation Costs in Radioactive Areas 73

Electric Heating for a Grade School in Pennsylvania ... 70

Consulting Engineers Fight to Improve Engineers' Status 72

Table Gives Discomfort Index Values at a Glance ... 99

House Tank and Storage Heater Piping Connections. 101

Control Center Regulates Mechanical Service Facilities in New Building 78

Thermostat Inside Unit Ventilator Betters Performance 97

New Equipment 115

New Catalogs 108

Ad-Digest 167

FOR OVER

82

YEARS

engineers and research specialists at Watts Regulator Company have directed their knowledge and applied their skills to the regulation of pressure (Water, Steam, Air). Watts has been an outstanding producer of PRESSURE REGULATORS and PLUMBING and HEATING SAFETY VALVES and CONTROLS — a dependable source of finest quality products.

For full data on Watts products (the world's largest line of Plumbing and Heating Specialties) we invite correspondence.

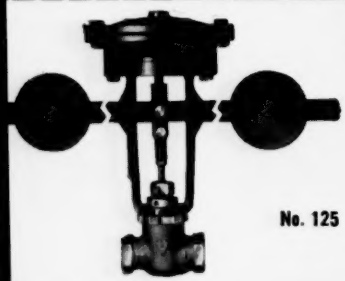
PRESSURE REGULATORS for Commercial, Industrial, Institutional application . . .

STEAM & AIR SERVICE

No. 127

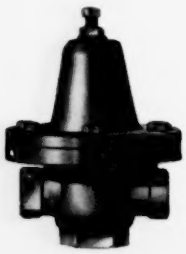
WATTS Nos. 127 and 125 Single Seated Pressure Regulators, Sizes ½" to 4". Initial Pressures up to 250 lbs.

No. 127 spring type — Reduced pressure range 10 to 100 lbs.



No. 125

No. 125 weight and lever type — Reduced pressure range 1 to 15 lbs.



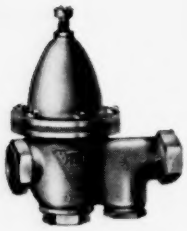
No. 152

WATTS No. 152 Self-Contained Single Seated Pressure Regulator, Sizes ½", ¾", 1".

Iron body construction with bronze trim for initial pressures up to 150 lbs. Reduced pressure ranges 5-40, 25-100 lbs.

Bronze body construction for initial pressures up to 250 lbs. and reduced pressures up to 200 lbs.

WATER SERVICE



No. 135

WATTS No. 135 Self-Contained Reducing Valve. All bronze unit incorporating integral strainer. Sizes ½" to 2". Initial pressures up to 250 lbs. Reduced pressure range 30 to 75 lbs.

No. 223S

WATTS No. 223 High Capacity Self-Contained Reducing Valve, Sizes ½" to 2". Also furnished with separate strainer, specify No. 223S. Initial pressures up to 250 lbs. Reduced pressure range 30 to 75 lbs.

No. 127W

WATTS No. 127W Remote Control Diaphragm Spring Type Pressure Reducing Valve, Sizes ½" to 3". Initial pressures up to 250 lbs. Reduced pressure ranges available from 10 lbs. to 100 lbs.

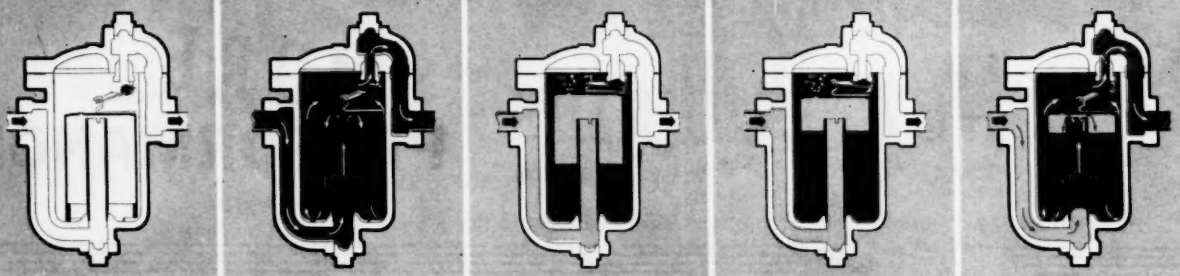
WATTS

Send for Folder F-135A (Regulators for Water Service)

WATTS REGULATOR COMPANY Lawrence, Massachusetts, U.S.A.

Folder F-127B (Regulators for Steam and Air Service)

This simple trap operating principle provides the efficiency, dependability and freedom from maintenance necessary for the most profitable use of steam



When trap is first installed, the inverted bucket is down and the valve is wide open.

When steam is turned on, condensate (solid color) flows into trap and out through discharge orifice, until —

Steam (light color) reaching the trap floats the inverted bucket and closes the valve.

When more condensate enters the trap, the bucket loses buoyancy and pulls on valve lever.

When weight of bucket times leverage overcomes pressure on valve, bucket sinks and opens trap.

Key: condensate · steam · steam bubbles · air bubbles

ARMSTRONG INVERTED BUCKET STEAM TRAPS

are designed and made to give you these big benefits:

● Amstrong Traps, the first inverted bucket steam traps, now represent the most advanced development of this time-proven principle. They provide all the advantages necessary for efficient, economical condensate drainage from virtually all types of steam using equipment.

1. *No steam loss* – Steam never reaches the orifice even when there is no condensate load.
2. *Automatic air elimination* – Vent in trap bucket passes air and other non-condensibles through to be discharged with condensate.
3. *No cooling leg required* – Condensate is discharged at steam temperature as fast as it reaches the trap because trap operates on difference in density between steam and water not on temperature.
4. *Operates on any back pressure* – Failure of one trap in system will not cause others to open because high back pressure does not affect an Armstrong trap other than to reduce capacity. As long as there is a pressure differential across the orifice the trap will close on steam and open for condensate.
5. *Unaffected by ordinary dirt* — Swirling action of condensate keeps dirt in suspension until discharged with condensate, prevents it from lodging in valve.
6. *Completely dependable* — Proved design plus the use of all stainless steel working parts assure continuity of service and length of service unmatched by any other trap.
7. *Big capacity in a small, economical package* — Armstrong design gives you the highest practical capacity for any given pressure. And remember, Armstrong capacity ratings are based on *hot* condensate at the *working pressure differential* stated, not on theoretical orifice capacities.

Further information on these advantages plus much additional information is given in the 48 page Armstrong Steam Trap Book. Ask your local Armstrong Representative or write direct.

860 Series for low pressure heating service.

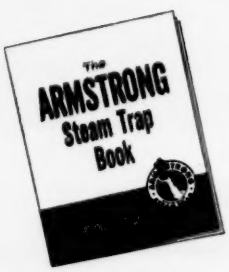
800 Series, side inlet, side outlet.

No. 801, side inlet, bottom outlet.

880 Series, integral strainer.

200 Series, bottom inlet, top outlet.

Forged Steel Series for high pressures, high temperatures.



The 48 page Armstrong Steam Trap Book tells how to correctly size, install and maintain steam traps for any pressure, any temperature, any load plus full catalog data on Armstrong Steam Traps. Ask for Catalog K.

ARMSTRONG MACHINE WORKS

8469 Maple Street • Three Rivers, Michigan

Skidmore Pumps

2 New Bulletins

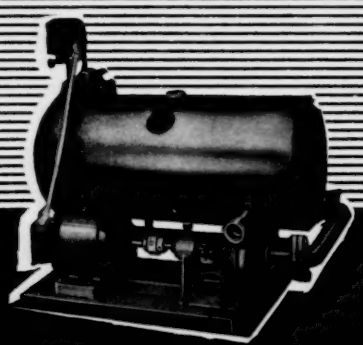
MORE CAPACITY

MORE PERFORMANCE

Send for Bulletin No. 21-C

TYPE CCVS

Send for Bulletin No. 14-B



TYPE HS

Since 1921

SKIDMORE PUMPS

SKIDMORE CORPORATION

ST. JOSEPH, MICHIGAN

AIR CONDITIONING HEATING AND VENTILATING

Volume 56, Number 6 **June, 1959**

EDITORIAL STAFF

EDITOR
Clifford Strock

ASSOCIATE EDITORS
Nathan N. Wolpert
William B. Foxhall
Harold M. Englund
Richard L. Koral

ADVERTISING REPRESENTATIVES

NEW YORK
Harry J. Twine
George W. Miller
93 Worth Street
CAnal 6-8120

CLEVELAND
Edward B. McEntee
17115 Hillsboro Rd.
IVanhoe 1-6857

CHICAGO
George G. Turner
Peter B. Impasto
228 N. LaSalle St.
FInancial 6-6864

BIRMINGHAM
Fred W. Smith
1201 Forest View Lane
TRemont 1-5762

DALLAS
Richard B. Hoierman
9006 Capri Drive
DAvis 7-3630

LOS ANGELES
Whaley Simpson Co.
6608 Selma Ave.

SAN FRANCISCO
Whaley Simpson Co.
700 Montgomery Bldg.

EXECUTIVE OFFICERS

PRESIDENT
Robert B. Luchars

VICE PRESIDENT-TREASURER
Edgar A. Becker

SECRETARY-PUBLISHING MGR.
Harold L. Gray

AIR CONDITIONING, HEATING AND VENTILATING is published monthly by The Industrial Press, 93 Worth Street, New York 13, N. Y. Executive, editorial and subscription offices, 93 Worth Street, New York 13, N. Y. • Entered as second-class matter August 31, 1956 at the Post Office, East Stroudsburg, Pa., under Act of March 3, 1879. • Subscription rates: In the United States and Canada, one year, $3; two years, $5; three years, $6; in Mexico, Central America and South America, one year, $4; two years, $7; three years, $8; in all other countries, one year, $7; two years, $12; three years, $14. Single copies, 50c. • Copyright 1959, by The Industrial Press. Permission required to reproduce articles. • Contents of AIR CONDITIONING, HEATING AND VENTILATING are indexed monthly by Industrial Arts Index and microfilmed by University Microfilms, Ann Arbor, Mich. • Member: National Business Publications, Business Publications Audit of Circulation, Inc., Society of Business Magazine Editors.

AIR CONDITIONING

Air Conditioning Increases Production, Government Agency Reports ... **67**
GSA finds office output improved nearly 10%.

HEATING

Electric Heating for an Elementary School ... **70**
Picture story describes Pennsylvania installation.

PROFESSIONAL BETTERMENT

Consulting Engineers Council Fights for Improved Status ... **72**
Report of meeting in New York.

VENTILATION

How Ventilation Costs Are Cut in Radioactive Areas ... **73**
Examples from Knolls Atomic Power Laboratory. ... T. T. Porembski

CONTROLS

Mechanical Service Facilities Regulated by a Control Center ... **78**
Installation in a new commercial building. ... C. J. Allen

PIPING

Reference Section—Time-Saving Procedure for Pipe Stress Analysis **81**
Design for flexibility without waste. ... K. Hao Hsiao

HEATING

Modern Technique for Unit Ventilator Control ... **97**
Thermostat inside the unit improves performance. ... J. Schwartz

INDUSTRIAL VENTILATION

What is Odor? ... **98**
An authority reviews measurement techniques.

PSYCHROMETRICS

Data Sheet—The Discomfort Index ... **99**
New table gives DI values at a glance.

PIPING

Detail Sheet—Piping Connections ... **101**
House tank connections; hot water storage heater.

HEATING

Sizing of Steam Heating Equipment ... **103**
Further study proposed to reduce costs. ... L. Smith

DEPARTMENTS

High Spots in the News ... **4**
Washington Overtones—L. Overman ... **8**
News of the Month ... **12**
Scientific Frontiers ... **16**
Piping and Plumbing—L. Blendermann ... **104**
New Literature ... **108**
Product Applications ... **111**
Degree-Days for April, 1959 ... **112**
Book Reviews ... **114**
New Equipment and Materials ... **115**
Briefly Stated News Items ... **140**
What Readers Say ... **154**
Canadian Degree-Days for April, 1959 ... **156**
Coming Events ... **158**
Index to Advertisers ... **164**
Ad-Digest ... **167**

HIGH SPOTS

Manufacturers of air conditioning equipment predict that production of room units will rise from last year's 1.35 million to about 1.70 million, and that shipments of central air conditioners will jump from 224,000 to 280,000, reports Time magazine. The industry expects that 10% of all new houses will be air conditioned. The reasons: a record number of new houses going up; increased spending generally; better industry promotion; more efficient merchandising (room units); and abundant hot, humid weather so far this year. The manufacturers are convinced that the biggest market, commercial and industrial, lies ahead. Cities throughout the country are rapidly approaching the point where 15% of their desirable office space is air conditioned, a point beyond which owners of the remaining 85% must install in order to compete. Also, there have been some recent dramatic break-throughs in the industrial field.

The world-wide demand for air conditioning is rising so sharply, according to Hobart C. Ramsey, chairman of Worthington Corp., that the estimated sales in Western Europe alone, for commercial, industrial and residential air conditioning made by all manufacturers, will double and possibly triple in the next five years. He indicated that part of Europe's anticipated swift rise in air conditioning will come through the abandonment of antiquated architectural restrictions which have inhibited the construction of completely modern structures.

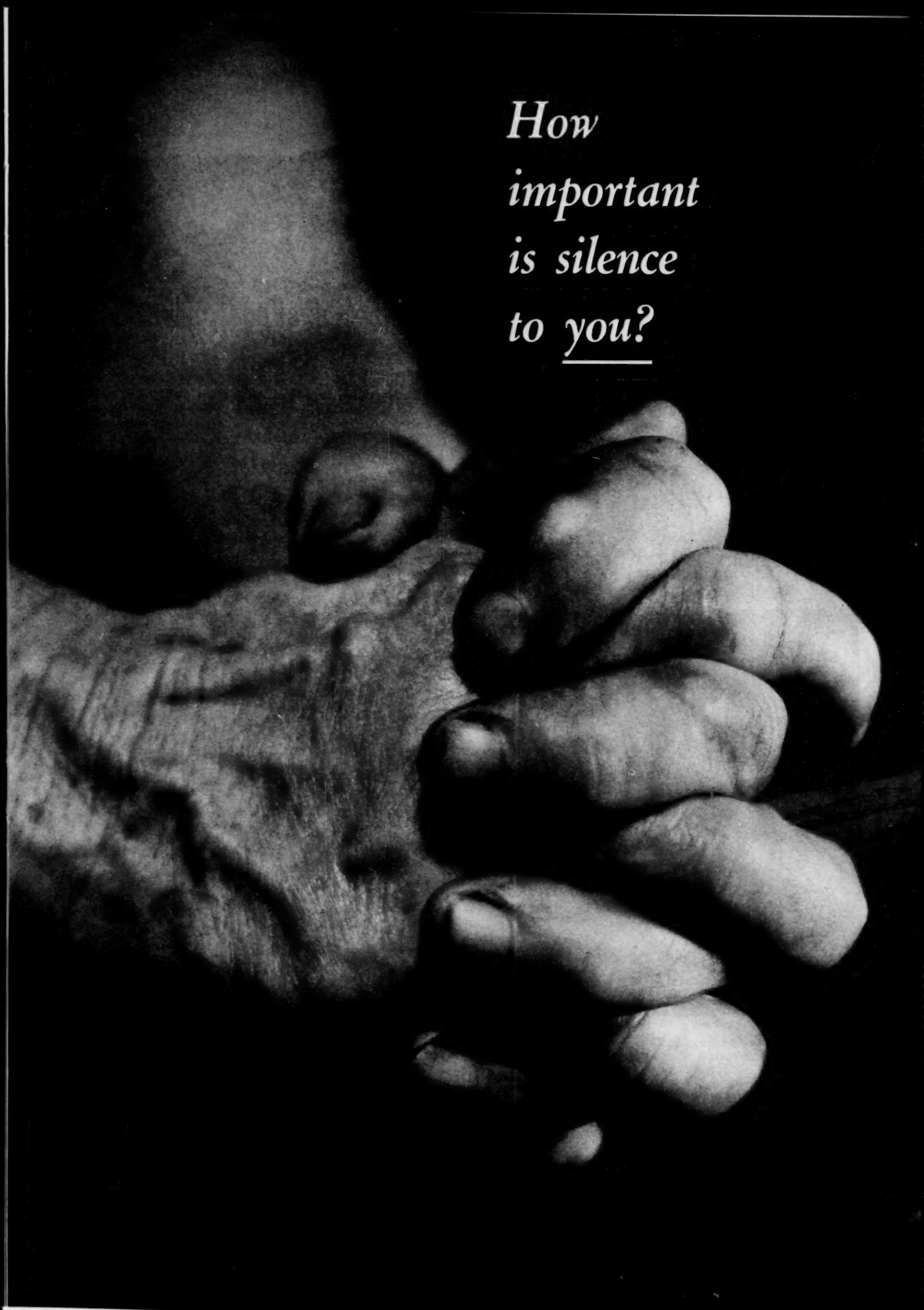
The number of companies participating in the ARI-NWAHACA Unitary Air Conditioner Certification Program has increased to 46, according to Air-Conditioning and Refrigeration Institute. A new directory, listing 1425 models of 38 of the 46 companies participating, is available from ARI.

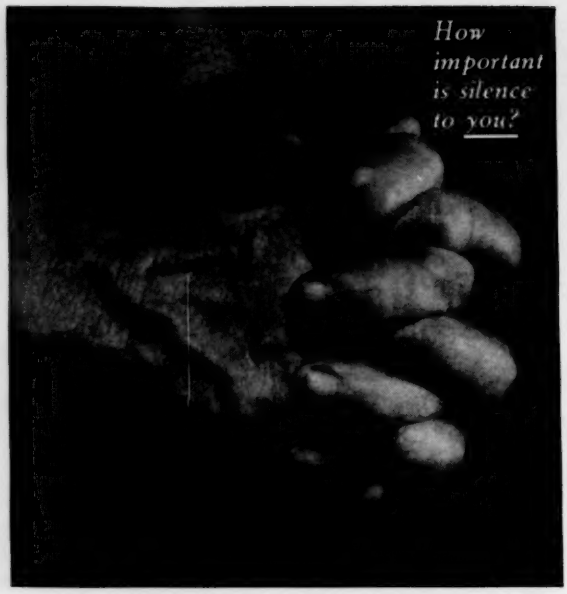
Almost 200 heating contractors from all parts of Connecticut attended a class on electric warm air heating and air conditioning held recently at Berlin, Conn. Class was sponsored by The Connecticut Light and Power Co. and The Hartford Electric Light Co., in cooperation with a number of heating and air conditioning wholesalers. This was one of a series of classes being conducted throughout New England to inform heating, air conditioning, and electrical contractors of the most modern methods of providing year-round indoor comfort.

Responsibility for the maintenance of temporary heat and temporary air conditioning should be clearly written into the mechanical contractor's specifications by consulting engineers and architects, according to a resolution approved by seven associations comprising the Joint Industry Program Committee. Resolution was formulated by the sub-committee on Temporary Heating and Cooling Specifications, created in January by JIPC. Reaction from an owner or general contractor group is now awaited.

Unit ventilator sales have been increasing, almost without interruption, in the past six years, statistics of the U.S. Department of Commerce show. The value of shipments during 1958 was $28.9 million, topping by over $4 million the shipments for 1957, and by almost $20 million those for 1952.

Manufacturers' shipments of compressor bodies wound up the calendar year 1958 about 10% below comparable shipments in 1957, it was reported by the Small Compressor Section of the Air-Conditioning and Refrigeration Institute, Washington, D.C., December shipments, however, were about 20% ahead of December the previous year, continuing a steady upswing which began in August. Actual shipments for 1958 totaled 3,559,057 bodies, compared with 3,962,142 in 1957. December shipments were 278,283 units, against 223,456 in December 1957. While the decrease from 1957 to 1958 was shared by most sizes of compressors, gains were shown in the latter year in 2- and 3-horsepower sizes.


How
important
is silence
to you?

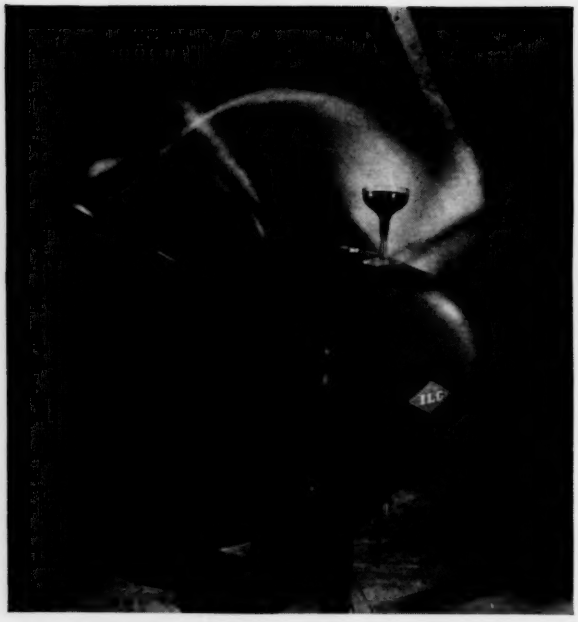


when it's silent operation . . .

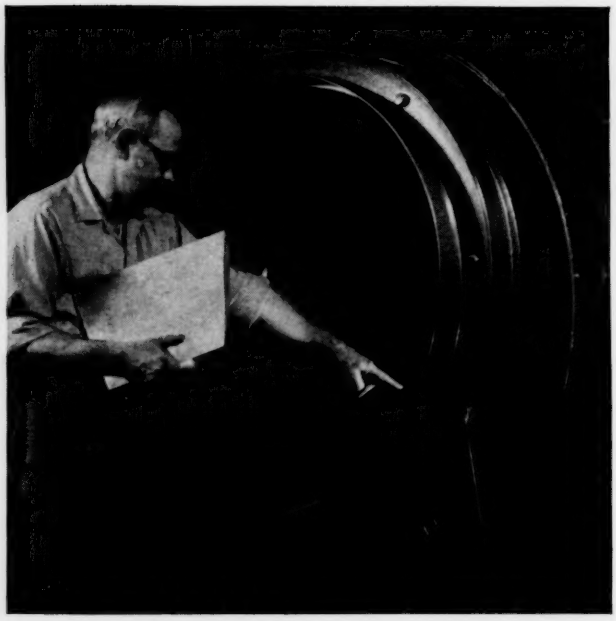
You know how important silence is in church . . . how out of place, how nerve-wracking noisy equipment can be.

So do consulting engineers . . . and the more than 500 churches that have recently put in Ilg fans and ventilators. They know that Ilg-built equipment always operates

Here's why ILG *fans and assure silent service,*



Not a Bubble in the Burgundy—due to vibration, that is. This 42" direct-connected, dynamically balanced, self-cooled Ilg propeller fan—turning at full speed—is so vibration-free that you have to look *below* the surface of the sparkling burgundy to spot any motion whatsoever.



Silent Centrifugal Performance starts with these backward curved (BC) blades and *airfoil* design that eliminate eddy currents and turbulence. Other "silencers" are: Ilg's smooth contour air intake; Ilg-built motors and direct-connected fan wheels. No belts or pulleys. Sized for operations to 9" static pressure.

For fans built to satisfy your "specs"...

Each ILG product shown carries the rating seal of the Air Moving and Conditioning Association, Inc.

510 churches thank ILG for electric ventilating equipment

quietly . . . economically . . . and for a *long, long time.*

Some of the reasons why Ilg ventilating equipment steadily gains in popularity are shown below. And regardless of the *size* or *type* of Ilg-built products you choose, you can count on complete satisfaction from an *operating cost* standpoint . . . from a *performance* standpoint . . . and from a *length-of-service* standpoint.

For further details on the complete line of Ilg electric ventilating equipment, send for Catalog No. 159 on propeller fans, Bulletin No. 257 on *airfoil* centrifugals, Bulletin Nos. 2302 and 2701 on power roof ventilators.

ILG *power roof ventilators*

vibration-free performance

Points to Your Profit. He's pointing out that Ilg *self-cooled* motor and *patented** pressure-type cooling of separate motor compartment eliminate heat build-up of *any* type. Also worth pointing out: Ilg backward curved (BC) blades and *airfoil* design for smooth, quiet air flow and low shock loss.

*Patent No. 2711682

Name Your Size. Ilg propeller fan power roof ventilators give you a choice of capacities. 11 different sizes for exhausting as little as 87 c.f.m. to 21,100 c.f.m. Under this low-height housing operate a vibration-free, direct-connected, Ilg-built motor and patented "Q" type fan wheel.

specify ILG

ILG ELECTRIC VENTILATING COMPANY

2851 N. Pulaski Road, Chicago 41, Illinois

Offices in 57 Principal Cities

Member of Air Moving and Conditioning Association, Inc. (AMCA)

WASHINGTON OVERTONES

by LORING F. OVERMAN

● Washington overtone of principal interest to air-conditioning, heating and ventilating industries during mid-May was the House Rules Committee's clearing of the Senate-passed omnibus housing bill (S.57) for House action.

The measure, rushed through the Senate less than a month after Congress convened in January, was considered by many in Washington as a test of the big-spending and budget-balancing forces. Action on the measure slowed when public reaction to "big spending" became apparent, and the House Rules Committee, by a 6-6 tie vote, doomed the proposals to a 10-week "cooling off" period.

Need to replenish dwindling FHA and FNMA funds forced the Rules Committee's hand, but unlimited amendments were anticipated when the measure reached the House floor. Unless tempered, the measure could face a Presidential veto.

● House Education Committee, by an 18 to 10 vote, has approved a $4.4-billion measure which would grant Federal aid for school construction and teachers' salaries on the basis of $25 for each school-age child. States would be permitted to determine how much of their annual allotment to use for either purpose.

● Another big-spending measure with overtones of interest to air-conditioning people is the proposed Welfare Department budget authorizing $181.4-million more than the Administration requested. The House-approved measure, appropriating $3.3-billion, was pending before a Senate Appropriations sub-committee at mid-May.

Of the increase, $42.5-million was to aid hospital construction; $25-million additional was for water pollution control.

● Food for thought for apartment builders and outfitters is the indication that a surplus of luxury-type apartments may be noticed later this year. Number of units started this year is 40% ahead of 1958, when starts hit a record total of 169,000.

Vacancies in rental rates have been rising gradually, reaching a postwar peak of 6.1% of available supply during the first quarter of 1959.

Problem may be further affected by the improved supply of low cost, easier-financed single-family housing.

● New construction put in place during April set a new high of $4.2-billion (dollar value) for the month, and resulted in a January-April record. Spending was up 107% in April over March, and 15% ahead of April of last year.

The January-April total was $15,130,000,000—13% ahead of the same period in 1958.

Outlook, assuming quick funding of FHA financing plans, is for sharp expansion of new building projects. Contract awards now 10% ahead of last year provide the cue.

● A long-range look at the housing outlook was undertaken late in May through a series of hearings arranged by Senator John Sparkman (D.Ala.), Chairman of the Senate Banking and Currency Subcommittee on Housing.

Hearings sought an answer to the question "Does the Decade 1961-70 pose problems in private housing and mortgage markets which require Federal legislation in 1960?"

The Senator explained: "It is generally agreed that during the next two years our economy will expand far beyond today's level. The rate of home construction, which has been at a constant level for the past several years, must increase to meet the needs of a growing population with a rising standard of living.

(Continued on page 10)

THE CHASE MANHATTAN BANK

World's Largest Completely Air Conditioned Building

Skidmore, Owings and Merrill
Architects

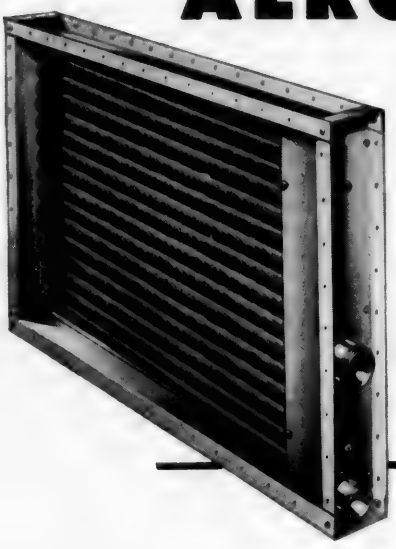
Jaros, Baum and Bolles
Mechanical Engineers

Turner Construction Co.
General Contractors

Raisler Corp. — Kerby Saunders, Inc.
Mechanical Contractors

. . . as in most modern buildings — commercial, industrial, institutional —

AEROFIN INSTALLED



Modern smooth-fin design of Aerofin coils permits ample heat-exchange capacity in limited space — permits the use of high air velocities without turbulence or excessive resistance.

Aerofin performance data are laboratory and field proved. You can safely specify Aerofin coils at full published ratings.

AEROFIN CORPORATION

101 Greenway Ave., Syracuse 3, N. Y.

Aerofin is sold only by manufacturers of fan system apparatus. List on request.

ENGINEERING OFFICES IN PRINCIPAL CITIES

WASHINGTON OVERTONES (Continued from page 8)

"The question of whether there will be adequate resources to take care of these new needs should be answered. Mortgage credit is the principal resource problem."

● There's less talk of inflation in Washington these days, but the subject isn't entirely forgotten.

House Resolution 7094 has been introduced by Rep. Lester Holtzman (D-NY), to give the President standby authority to invoke a 90-day freeze on prices and wages" whenever he shall find and declare the existence of a threat to the economic stability of the United States . . ." The Bill is similar to one which Mr. Holtzman introduced in the 83rd Congress. Present measure was referred to the Banking Committee.

● Electric utilities statistics for 1958—including production of energy and consumption of fuels—are available in two reports obtainable at 10 cents each from the Federal Power Commission, Washington 25, D.C.

For the year ended March 31, fuel consumption included 158,901,756 tons of coal; 85,402,850 barrels of oil; and 1,397,255,922,000 cubic feet of gas. These amounts represent a decrease of 0.4% for coal, but gains of 12.5% for oil and 5% for gas, over the corresponding period of 1957-58.

● The Bureau of Mines has reported that imports of petroleum products have been reduced sharply as a result of the mandatory oil import program. Product imports dropped from over 1,000,000 barrels per day for the first three months of 1959 to 550,000 barrels per day in April. Similar totals are estimated for May and June, the Bureau indicated.

● Two innovations—fresh water from saline water, produced by atomic heat! These twin accomplishments may be the result of negotiations now under way. As announced by Interior Secretary Fred A. Seaton, the project would produce 1,000,000 gallons of fresh water per day.

Improved designs worked out by the Department and by industrial research may reduce the capital cost as much as 45%, compared with estimates of previous saline water conversion operations.

● Before too long, oil may move under water via nuclear powered submarine tankers.

Electric Boat Division, General Dynamics, Groton, Conn., has a Maritime Commission authorization to prepare drawings and test models of a 20-knot, 20,000-ton nuclear powered sub tanker. Preliminary studies have indicated its feasibility.

● The House Interior Committee has approved legislation to set up a three-member Coal Research Commission, with an initial budget of $2,000,000 in fiscal 1960, and "such sums as may be necessary" for future years. The Committee turned down a recommendation by the Interior Department that the Bureau of Mines have jurisdiction over any expanded coal research.

The proposed commission would be authorized to conduct its own research, but only if unable to complete contracts on reasonable terms with schools or private research organizations.

● Rudolf G. Berg, vice president of Copeland Refrigeration Corp., Sidney, Ohio, was elected president of the Air-Conditioning and Refrigeration Institute at its annual meeting on May 4 in Hot Springs, Va. He succeeds Don V. Petrone, President of Typhoon Air Conditioning Co.

Other officers include three vice presidents—Russell Gray, vice president of Carrier Corporation; L. N. Hunters, vice president of National-U.S. Radiator Corp.; and R. K. Serfass, general manager of Air Conditioning Div., Westinghouse Electric Corp., and a treasurer, W. H. Aubrey, vice president of Frick Company.

Dunham-Bush Issues 10 Year Vacuum Pump Receiver Warranty-Reaffirms Continuance of Quality Product Lines

Recognizing a general industry trend to put price in a paramount position and inherent dangers of quality control in such a concept, Dunham-Bush has taken this step.

DUNHAM-BUSH, INC.

10 Year Warranty

VACUUM PUMP RECEIVER

Pioneering in the interests of specifier, installer and owner, Dunham-Bush has issued a ten year warranty on their vacuum pump receivers. This warranty is a clear cut expression of the manufacturer's confidence in their product performance and willingness to back up this expression of confidence with a written warranty.

The Dunham-Bush ten year warranty reads as follows: "The Company hereby warrants the receiver tank of this vacuum pump for ten years from the date of installation while owned by the original purchasor, provided nonelectrolytic corrosion occurs and the condensate is not wasted, but is repeatedly reused, the make up water to be only that required to replace small amounts that might be lost through stuffing boxes or similar.

Liability under this warranty is the same as those contained in the Company's standard 'Condition of Sale' (except that this warranty is for a period of ten years)."

Attesting to an integrity of manufacturing that has guided the Dunham-Bush product lines since 1903, this latest step insures continued quality with today's modern production and pricing methods.

The Dunham-Bush vacuum pumps with copper bearing steel receivers, offer many outstanding features for dependable and economical operation.

How Simple Two Cycle Operation Works

One simple moving element—the pump impeller—(1) forces water through the exhauster, creating a vacuum for constant circulation of steam, vapor and condensate through the heating system piping, and (2) creates a positive pressure for delivering condensate to the low pressure boiler.

Dependable - Low Cost Maintenance - Easy Installation

No adjustments needed for close tolerances of moving parts:

- Only one principal moving part.
- Capable of producing 26-in. vacuum at low amperage.
- Low inlet connections.
- One motor handles both air and condensate removal.
- Heavy-gauge (10 year warranty) copper bearing steel tanks.
- No vacuum on stuffing boxes.

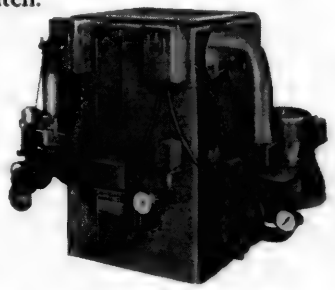
A Complete Dunham-Bush Pump Line

Type VR, Model C2. Single Unit. 2500 through 20,000 EDR.
Type VRD, Model C2. Duplex Unit. 2500 through 20,000 EDR.
Type VR, Model B2. Single Unit. 25,000 through 65,000 EDR.
Type VRD, Model B2. Duplex Unit. 25,000 through 65,000 EDR.

And A Complete "All-In-One" Pump Package

All standard units are rated in accordance with ASHRAE vacuum heating pump code. No "extras" to buy.

All single unit pumps have heavy-duty float switch, vacuum switch and magnetic starter with selector switch.



All duplex units are equipped with mechanical alternators for stand-by service plus alternate pump operation from one pump to the other on float control.

All necessary controls mounted and wired for immediate use.

All units, single and duplex, have gage glass, heavy copper bearing steel receivers, with 10 year warranty, of large capacity, yet designed to conserve floor space.

File 1401B gives complete Dunham-Bush vacuum pump specifications and details. Yours for the asking. Sample warranty available for inspection.

Dunham-Bush, Inc.

AIR CONDITIONING, REFRIGERATION, HEATING PRODUCTS AND ACCESSORIES

WEST HARTFORD 10, CONNECTICUT

NEWS OF THE MONTH

AWARD WINNERS

announced by ACH&V publisher. Fifty-one colleges pick their outstanding students for honors.

In an effort to encourage scholarship, The Industrial Press during May presented an award to the outstanding student in courses involving heating, ventilating and air conditioning in a number of colleges and universities throughout the United States. The award includes a *Handbook of Air Conditioning Heating and Ventilating* and a Certificate. It will be given annually.

This year, the first year the award has been made, 51 colleges participated. Chosen as the outstanding students in their respective classes by their instructors were the following students: Kim C. Cannon, Duke University; Larry Drake, Oklahoma State University; William K. Stephenson, The University of Texas; Emil Joseph Leidolf, Jr., A & M College of Texas; James Allen Utz, University of Dayton; Donald G. Reese, The University of Toledo; Richard John Kemen, University of Florida; Jerome A. Anderson, The University of Wisconsin; Sherwood B. Bliss, Cornell University; Gerald D. Smith, University of Utah; Joseph B. Branom, Texas Technological College; Wyvil R. Kendall, University of Washington; Robert R. Burghardt, Marquette University; Richard A. Terselic, Case Institute of Technology; Russel L. Larson, University of Arizona; William R. Perry, University of Alabama; W. T. Hinds, Northwestern University; M. Herbert Wachs, Drexel Institute of Technology; J. D. Daddario, Jr., Worcester Polytechnic Institute; John W. Norris, Jr., Massachusetts Institute of Technology; J. D. Potts, University of Missouri; Donald A. Thome, Oregon State College; David L. Lewis, The Ohio State University; Dale R. Galliart, Kansas State College; Dean R. Frey, Pennsylvania State University; Victor Bach, University of California; John E. Foss, North Dakota State College; Bryan Gillespie, University of Oklahoma; Robert Doyle Holstead, Louisiana Polytechnic Institute; Robert E. Alt, University of Pittsburgh; William Mitchell Unger, West Virginia University; W. H. McCown, Clemson A & M College; Albert Scavino, California State Polytechnic College; Richard Lee Conrath, University of Illinois; Robert Dean Holly, University of Wyoming; Ernest Menold, University of Notre Dame; Thomas Harold Varley, University of Maryland; James F. Burner, Virginia Polytechnic Institute; Tim R. Miles, Vanderbilt University; LaVerne W. Rees, University of Minnesota; Richard Rea Hinch, Georgia Institute of Technology; James H. Blow, Jr., Howard University; Will L. Liddell, Jr., Alabama Polytechnic Institute; Edmond A. Haddad, University of Southern California; James Byron Moody, University of Colorado; Phillip Stephen Cates, The University of Tennessee; Duane E. Deonigi, State College of Washington; Allan F. Maguire, Syracuse University; and Stanley Y. Nakomoto, Milwaukee School of Engineering.

Richard A. Terselic, a senior mechanical engineering student at Case Institute of Technology, receiving The Industrial Press Award for outstanding scholarship in heating, ventilating, and air conditioning. A similar award was made at over fifty engineering schools. (Left to right) Professor W. L. Bryan, Associate Professor of Heat-Power Engineering; Mr. Terselic; Dr. R. E. Bolz, Head, Department of Mechanical Engineering; Dr. T. E. Baker, Dean of Students, all of Case Institute of Technology, Cleveland.

NEW TECHNIQUE

for estimating dispersal of airborne contaminants presented at Chicago Industrial Health Meet.

Just how much pollution the atmosphere can dilute into insignificant concentrations is a waste disposal problem of extreme interest to industry, according to H. E. Cramer of Massachusetts Institute of Technology, who addressed a session on air pollution at the Industrial Health Conference at the Sherman Hotel in Chicago.

The cost of removing all pollutants at the point of emission is often too great to be practical, he pointed out, thus, efficient use of this natural waste disposal system is essential. The quantity of contaminants that can be discharged without contributing significantly to pollution is dependent upon reliable estimates of atmospheric dispersal capacity which varies widely according to wind direction and velocity, topographical features of the area, the temperature of the effluent at the time of emission and the air temperature.

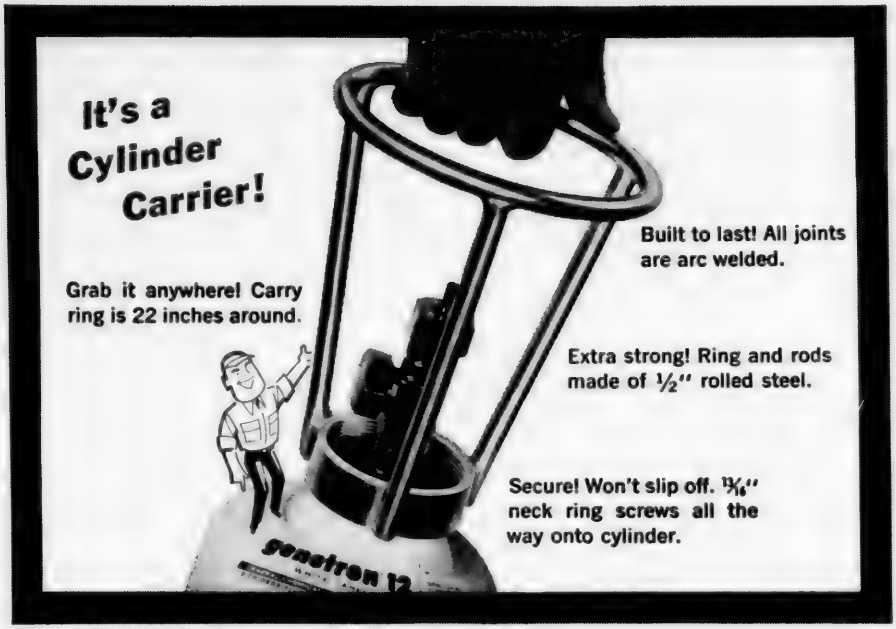
Mr. Cramer presented a new tech-

(Continued on page 14)

A GIFT FROM YOUR WHOLESALER

FREE! GENETRON CARRY-STAND

Yours! During July or August with purchase of 22 lbs. or more of genetron® SUPER-DRY REFRIGERANTS!


It's a Cylinder Carrier!
Grab it anywhere! Carry ring is 22 inches around.
Built to last! All joints are arc welded.
Extra strong! Ring and rods made of ½" rolled steel.
Secure! Won't slip off. 13/16" neck ring screws all the way onto cylinder.
genetron 12

Interchangeable!

Ideal for service use. Use on any 10 lb. or 25 lb. refrigerant cylinder.

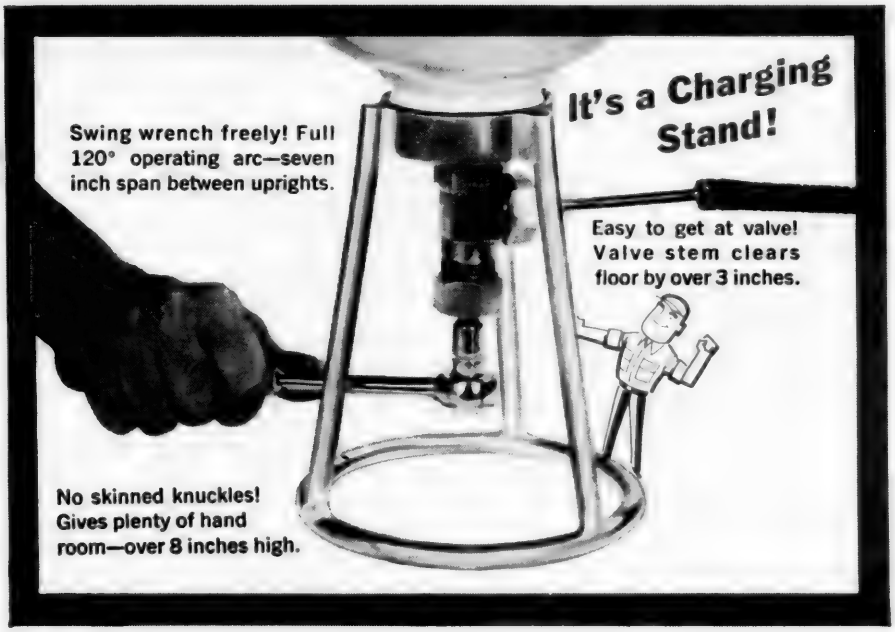
Big Value!

Worth at least $5 retail! Yours free when you buy "Genetrons" during July or August. Don't miss it.

SUPPLY LIMITED!

See Your Wholesaler Early

Only One to a Customer!


It's a Charging Stand!
Swing wrench freely! Full 120° operating arc—seven inch span between uprights.
Easy to get at valve! Valve stem clears floor by over 3 inches.
No skinned knuckles! Gives plenty of hand room—over 8 inches high.

Allied Chemical

GENERAL CHEMICAL DIVISION

40 Rector Street, New York 6, N. Y.

(Continued from page 12)

nique for estimating the dispersal of airborne contaminants based on the use of direct meteorological indicators. Estimates obtained by this method are believed sufficiently accurate to provide a basis for resolving many industrial air pollution problems, it was said.

ASHRAE ANNUAL MEETING

features eight technical sessions, plus domestic refrigerator, industrial ventilation conferences.

The technical program of the annual meeting of the American Society of Heating Refrigerating and Air-Conditioning Engineers, New York, N.Y., includes eight technical sessions and three conferences, which will take place between 9:30 a.m., Monday, June 22, and Wednesday noon, June 24.

Scheduled for Monday are sessions on compressors, ventilation, domestic refrigerators, as well as a Welcome Luncheon and afternoon forums.

Sessions on noise, heat transfer, and industrial ventilation are featured Tuesday. General refrigeration, air conditioning, and cryogenics are slated for discussion on Wednesday.

ASHRAE will hold its Semiannual meeting in Dallas, Tex., February 1-4, 1960 in connection with the Second Southwest Heating and Air-Conditioning Exposition in Dallas' Memorial Auditorium.

ARI BOWS TO NEMA

as ARI Room Air Conditioner Section is inactivated. Two groups reconcile their tax stands.

The Board of Directors of the Air-Conditioning and Refrigeration Institute, Washington, D.C., voted to inactivate the Room Air-Conditioner Section of ARI.

During the past several months, ARI and the National Electrical Manufacturers Association, New York, N.Y., which has recently formed a Room Air-Conditioner Section, have discussed their common interests in many matters, including equipment standards and federal excise taxes.

Recognizing the community of interest between the two associations regarding the air-conditioning industry, it has been agreed to form a liaison committee made up of members of both to discuss and consider matters of common interest.

SERIES OF FIRSTS

marks Building Research Institute Annual Meeting. All areas of the building industry attend.

Organized as a trial balloon to test the pattern of future Building Research Institute multi-subject conferences, the 8th Annual Meeting of the Institute at Pittsburgh's Penn-Sheraton Hotel in April was the first BRI meeting to hit a total registration of more than 675. BRI officers are enthusiastic over the turnout, which was composed of a cross-section of the building industry, including architects, contractors, engineers, building owners, building products manufacturers and distributors, appraisers, government building officials, financiers, and building research specialists from colleges and universities, as well as private consultants.

First of the firsts, was the announcement from the opening session platform that the first speaker for the general session, Robert W. Dowling, had just been appointed chairman of the Advisory Committee for a National Cultural Center in Washington by President Eisenhower. Dowling, who is president of City Investing Company of New York and an internationally known expert on building finance and urban planning, directed his remarks toward stimulating an increased awareness in the building industry of the need to keep our country beautiful. This, he said, can be accomplished through enlightened city and community planning, and he cited the new development of Sterling Forest, 30 miles from New York as an example. This community, he said, will have no building higher than the trees . . . no building visible from any angle except the air, until you approach it immediately.

Another first was the closing session of the meeting, which for the first time brought together on one platform the research directors of six of the nation's major producers of building materials.

Dr. S. W. Herwald, representing Westinghouse Electric, predicted a great advance in heating and cooling systems operated on electric power for all types of buildings, and particularly a great increase in the use of electric heating. This last, he based on the fact that his company's most promising approach lies in its current work on development of effective heat pumps. He said, also, that there is every evidence now that in the very near future it will be possible to combine in a single panel an element that will provide perfect control of both temperature and light, simultaneously. This he demonstrated with an experimental model on the platform.

ROTTERDAM CONGRESS

will review world building research. Pre-prints of papers, and proceedings in English promised.

The 1959 Congress of the International Council for Building Research, Studies, and Documentation (CIB), will take place in Rotterdam, The Netherlands, September 21-25. It is open to all CIB members, their representatives, and to other interested experts.

Primary purpose of CIB, which was constituted in 1953 under the aegis of the United Nations, is to encourage and facilitate international cooperation in building research, studies, and documentation, covering technical, economic, and social aspects of building.

Following are subjects covered in plenary sessions: (1) Design and calculation of constructions; safety factors; (2) Sociological and functional aspects of housing design; (3) Introduction to the normalization of dimensioning on the building site, tolerances, and dimension control; (4) Research problems concerning heavy concrete elements; (5) Mass housing in rapidly developing tropical areas; (6) Flat roofs; (7) Fundamental aspects of transmission of knowledge; and (8) Heat insulation and other means of saving fuel for heating dwellings.

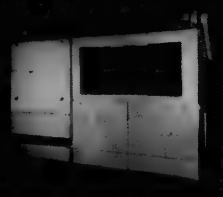
Congress papers, in English or French, will be sent to delegates beforehand. During plenary sessions, simultaneous translations of the proceedings into English, French and Russian will be arranged.

422 Reasons Why...

YOU CAN "DESIGN" YOUR OWN AIR CONDITIONING AT . . Governair

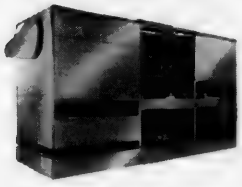
©SATISFABRICATED" TO SUIT YOUR REQUIREMENTS

Self-Contained Unit
With Evap. Condenser Type SCU



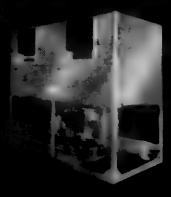
From 11 Basic Models
30 Possible Combinations

Self-Contained Unit
Multi-Zone Type SCMZ



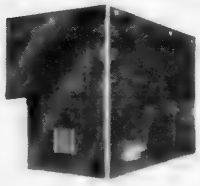
From 11 Basic Models
50 Possible Combinations

Self-Contained Unit
Shell and Tube Type ST



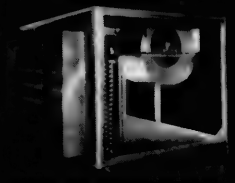
From 13 Basic Models
25 Possible Combinations

Self-Contained Unit
Multi-Zone Type STMZ



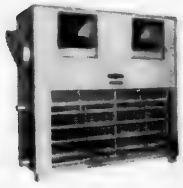
From 13 Basic Models
25 Possible Combinations

Horizontal Air Conditioner
Type GHC



From 14 Basic Models
56 Possible Combinations

Vertical Air Conditioner
Type GVC



From 14 Basic Models
56 Possible Combinations

Multi-Zone Air Conditioner
Type GMZ

From 14 Basic Models
84 Possible Combinations

Evaporative Condensers
Type EC

From 14 Basic Models
28 Possible Combinations

*ChillPak Water Chiller
Type CPS

From 10 Basic Models
68 Possible Combinations

*Cabinet models available with built-in or remote evaporative condenser.

ORIGINATORS AND DEVELOPERS OF COMPLETELY PACKAGED AIR CONDITIONERS

NATIONAL REPRESENTATION IN PRINCIPAL CITIES. SEE YOUR LOCAL YELLOW PAGE PHONE DIRECTORY.

GOVERNAIR

WRITE FOR FURTHER INFORMATION ON ANY SPECIFIC UNIT, OR SEE OUR LISTING IN ASHACE "GUIDE."

4840 N. SEWELL • OKLAHOMA CITY, OKLAHOMA

Scientific Frontiers

Extremes in Pressure Research

The two extremes in pressure research were discussed recently in separate articles in *Science*, the publication of the American Association for the Advancement of Science.

In his article, "Ionic Vacuum Pumps", Lewis D. Hall states that with the continued growth and refinement of high-vacuum techniques, there is an increasing interests in methods of obtaining high vacuums by means that will minimize the introduction of contaminants into the vacuum system. In addition, methods are being sought which will make it possible to obtain ultrahigh vacuums without the use of such auxiliary procedures as refrigerating the system.

The terms *high vacuum* and *ultrahigh vacuum* deserve some discussion. As in the case of the analogous terms *high* and *ultrahigh purity*, their meanings have changed considerably with time. Today, the term *high vacuum* signifies to most specialists pressures of 10^{-6} mm-Hg or below; *ultrahigh vacuum* pertains to pressures below 10^{-8} mm-Hg. As pumping techniques have improved, pressures have been pushed to lower and lower values, and this in turn has led to further refinement of techniques. Those old standbys, the oil diffusion pump and the mercury diffusion pump, are beginning to be replaced in certain applications by devices which can be classified under the general heading of ionic pumps, so-called because of the fact that the pumping mechanism depends in part, at least, upon the production of electrically-charged particles, or ions.

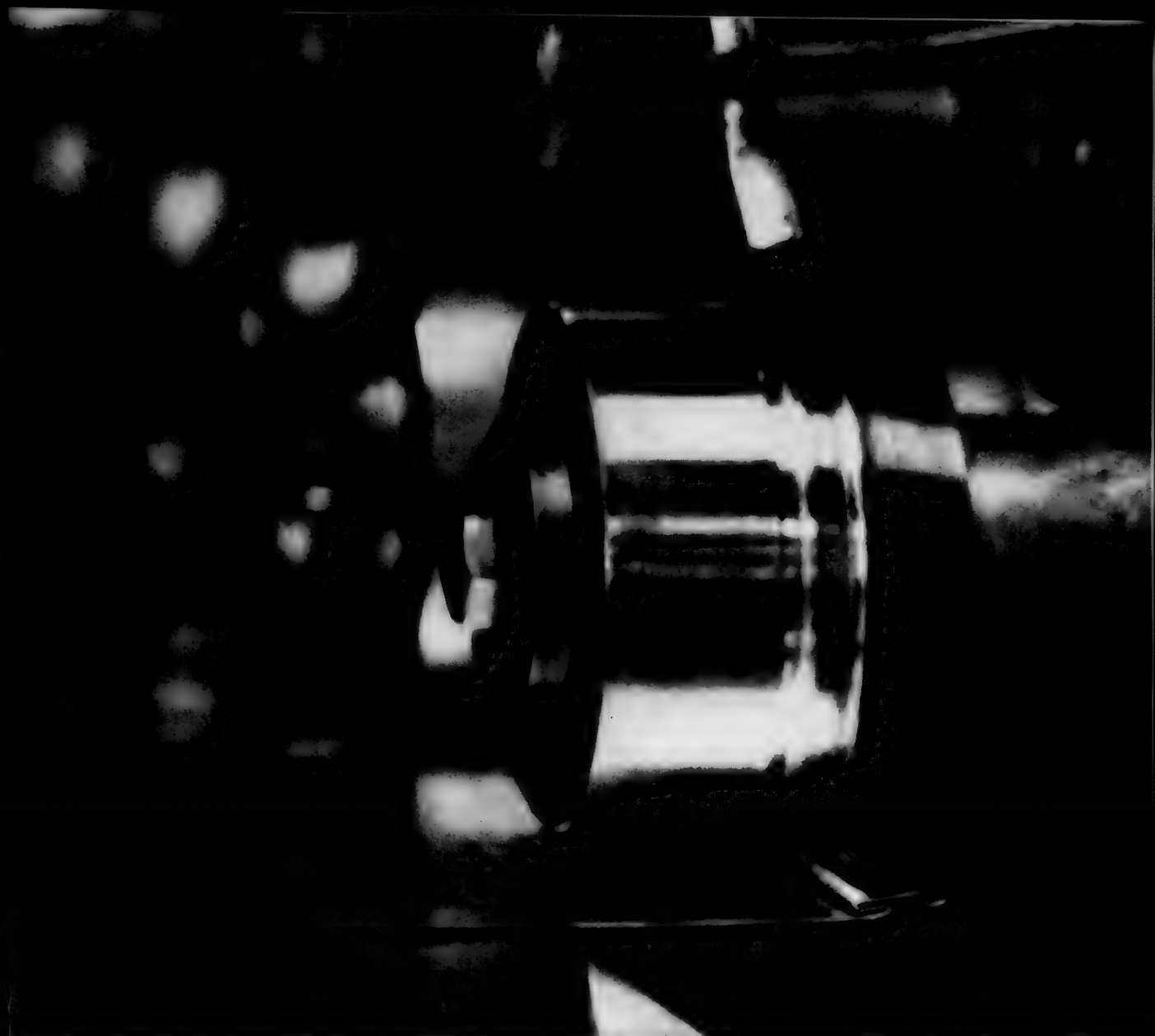
Some of these ion pumps depart radically from the intuitive definition of "pumping" in that gas particles are not pumped out of the system into the atmosphere, but instead are simply transferred from the gas phase to the solid phase inside the system. Such pumps are sometimes referred to as "getter" pumps because their pumping action is similar to the action of getters used to improve the vacuum in electron tubes. It is therefore convenient to generalize the term *pumping* to mean any process by which the number of molecules in the gas phase in the system is caused to decrease.

Progress in high-pressure research, according to H. Tracy Hall in his article, "Ultrahigh-Pressure Research", is directly dependent on progress in design of high-pressure apparatus.

Heat energy is a type of energy that man has deliberately applied for ages to effect transformations in materials. Temperatures of 1000 to 1500 deg C, readily obtainable in flames and furnaces, introduce energies in the order of magnitude of 10 kilocalories. These energies correspond to the ordinary energies of chemical bonds; hence, interaction of this heat energy with matter will produce atomic and molecular rearrangements.

What magnitude of pressures corresponds, in energy, to temperatures of 1000 and 1500 deg C and, hence, might be expected to produce changes in scope and magnitude comparable to those that are produced by these temperatures? For condensed systems—that is, liquids and solids—corresponding pressures would be in the order of 100,000 to 200,000 atmospheres. These are presently obtainable.

The use of pressure and temperature together as "levers" to manipulate systems (thermodynamically and rate-wise) to obtain a desired result offers far greater possibilities than the use of either alone. The generally diametrically opposite behavior of pressure and temperature carries into the realm of reaction rates. Whereas rates of reaction are increased by increasing temperatures, increasing pressures decrease the rates. Consequently, for proper control of reaction rate, it becomes very desirable to have apparatus available that can produce high pressures and high temperatures simultaneously.



"LOCK SEAMS GIVE US TROUBLE? NO SIR—WE USE WEIRKOTE !"

When it comes to the rigors of lock-seaming, nothing can take it like Weirkote.

Why? Because Weirkote combines the strength of steel with a tightly bonded continuous process zinc coating that remains intact through the severest fabricating steps. No chipping. No peeling. In fact, Weirkote can be worked to the very limits of the steel itself and still come through with a smooth, even, corrosion-resistant zinc coating on both sides of every crease.

So whether your product is crimped or drawn, spun or twisted, Weirkote means a new high in production results, corrosion prevention and customer goodwill—a new low in costly, worrisome rejects.

Weirkote's low initial price, combined with these production savings, insures the economical quality you may have been looking for. Why not investigate further by sending for the 12-page Weirkote booklet that explains how Weirkote can help you both in your products and in your production. Just write to Weirton Steel Company, Dept. N-13, Weirton, West Virginia.

WEIRTON STEEL COMPANY

WEIRTON STEEL COMPANY

WEIRTON, WEST VIRGINIA

a division of

NATIONAL STEEL CORPORATION

For the first time!

Everything you need in Dial Thermometers for Piping *and* Duct work!

A new and complete line of instruments: Dial thermometer of Marsh precision and accuracy designed down to the last detail for piping and duct work . . . for use on heating and cooling equipment, air ducts, vessels and kilns, ovens and similar applications.

Easier to read

Illustrations tell the story. Four types, seven ranges—72 stock combinations to meet every condition. Big, legible 3½" and 4½" dials . . . easy to read in places where piping and duct thermometers must be installed. Ease of reading further increased by provision for tilting and turning dials to any desired reading angle. Line includes distant reading types that take care of remote locations.

Unbreakable—more accurate

Instead of fragile difficult-to-read glass tube thermometers you now have sturdy, unbreakable, legible Marsh Dial Thermometers. Guaranteed accurate to plus or minus one division of the scale, they have far greater *readable* accuracy than any glass tube type. All have the famous Marsh "Recalibrator"—to *keep* them accurate.

All purpose

Design provides for every on-the-job condition. Separable sockets ("wells") simplify installation—or removal for servicing. Extension necks take care of insulation on piping or ducts. Long stems in duct type put temperature-sensitive section where it belongs.

Note the brief specifications opposite. Any thermometer is available from stock.

Write for bulletin telling the whole story.

Jas. P. Marsh Corporation

Dept. U, Skokie, Ill.
Marsh Instrument & Valve Co. (Canada) Ltd.
8407 103rd Street, Edmonton, Alberta

For piping

Dial sizes: 3½" and 4½"

Ranges:
0° to 100°F for chilled water
20° to 120°F for condenser water
40° to 240°F and 100° to 300° for hot water and domestic water

¾" NPT connection

All ranges, in both direct mounted and remote reading types, available with three standard sockets shown in drawing below.

For ducts

Dial sizes: 3½" and 4½"

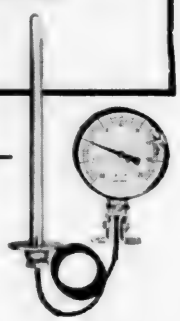
Ranges: −40° to +120°F
0° to 160°F
0° to 220°F

All ranges, in both direct mounted and remote reading types, available with standard extension necks and stems shown in drawing below.

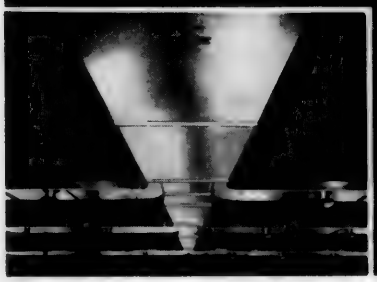
MARSH
DIAL THERMOMETERS

Also remote reading—

Piping and duct thermometers of same basic design available with 6 ft. of capillary tubing as shown.



SOFTITE BY WHEELING



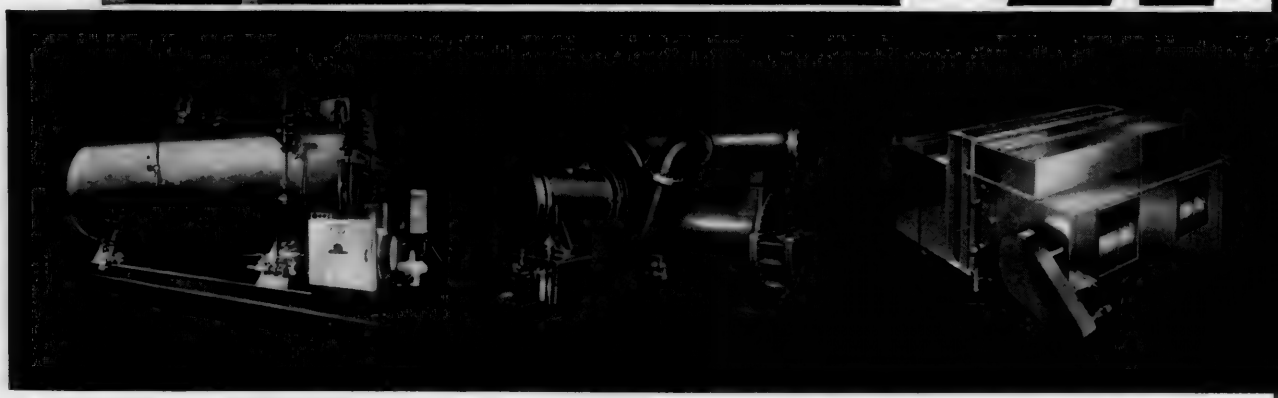
Take a good look!

OUR CHALLENGE STANDS!

It's easy to see why our challenge stands: *Anything that can be made of steel sheets can be made of Wheeling SOFTITE Galvanized Steel Sheets.* SOFTITE will not flake or peel! Let us show you how this *modern* galvanized sheet can help you do a better job . . . and do it easier! Wheeling Steel Corporation, Wheeling, West Virginia.

WHEELING STEEL CORPORATION · IT'S WHEELING STEEL! *District Sales Offices at Atlanta, Boston, Buffalo, Chicago, Cincinnati, Cleveland, Detroit, Houston, New York, Philadelphia, St. Louis, San Francisco, Wheeling*

Evaluating equipment



Firebox, scotch-type steel boilers and package units for heat, power, steam.

Centrifugal refrigerating machines for central-station air-conditioning systems.

Central-station air-conditioning units for public buildings, industrial plants.

One call for all

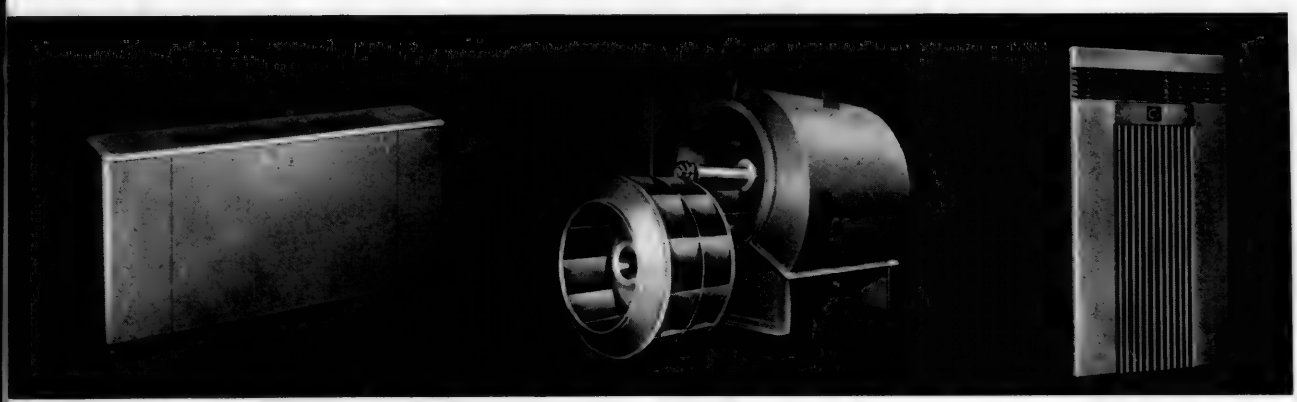
for your air-conditioning job?

Be sure one of the sources you consider is

AMERICAN-Standard Industrial Division

HERE'S WHY: This one organization encompasses the six major fields of air conditioning, heating, ventilating, heat transfer, dust collection, and fluid drives . . . to offer one-source responsibility for quality and performance in equipment that is designed, engineered, and manufactured to work together.

By combining the engineering backgrounds and product lines of three American-Standard* divisions – American Blower, Ross Heat Exchanger, and Kewanee Boiler – the new Industrial Division brings many benefits to *all* business and industry. There are engineer-staffed offices in all principal cities to work with architects, consulting engineers, and contractors with equipment selection and on-the-job problems. Contact the one nearest you. American-Standard Industrial Division, Detroit 32, Michigan. In Canada: American-Standard Products (Canada) Limited, Toronto, Ontario.



Fancoil units for cooling and heating individual rooms in multi-room structures.

Heavy-duty centrifugal fans for high pressure air conditioning or ventilating needs.

Packaged commercial air conditioners, air- or water-cooled types, 3 to 20 tons.

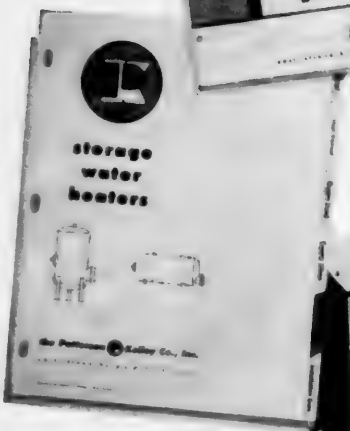
*AMERICAN-Standard and Standard® are trademarks of American Radiator & Standard Sanitary Corporation.

AMERICAN-Standard
INDUSTRIAL DIVISION

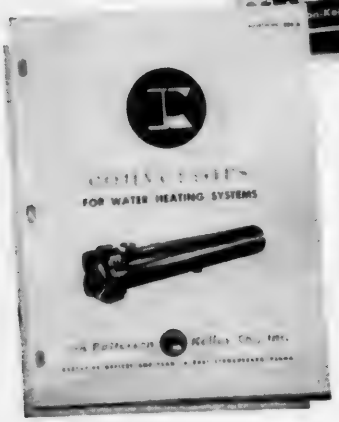
AMERICAN BLOWER PRODUCTS • ROSS PRODUCTS • KEWANEE PRODUCTS

In Bulletin No. 6050 on P-K forced boiler water heat exchangers complete capacity tables are provided, grouped by temperature ranges. Pressure drop is shown for each capacity. Dimensional data supplied

Catalog No 19 covers P-K storage water heaters in plain steel, copper-lined, copper silicon, Pre-Krete lined, clad and galvanized. In addition to tabular data on capacities, weight and dimensions, this book carries a handy conversion table to determine capacities of heating sections with various temperature ranges and steam pressures



Catalog No. 202 describes P-K instantaneous water heaters Contains capacity tables covering two, four and six pass design. Tables are grouped by steam pressures ranging from 0 to 100 psi. Inlet and outlet temperatures are listed with hot water capacities.



In this P-K Bulletin No. 303-A, covering convertors for forced circulation water heating systems, capacity tables include the usual ranges for standard water heating systems. Also included are general ranges for radiant heating systems.

DESIGN AIDS for any hot water system

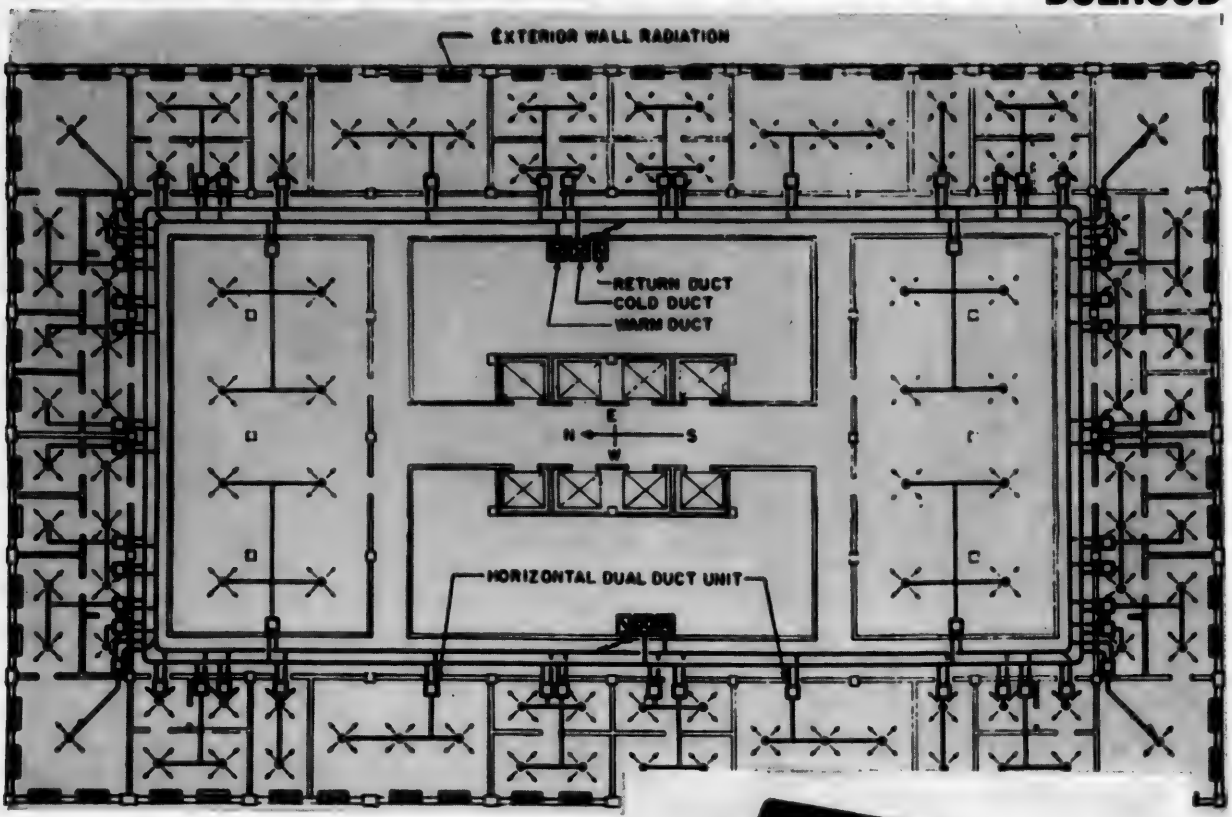
With these four P-K catalogs on your desk you have installation and performance data, conveniently tabulated on instantaneous hot water heaters, storage water heaters, convertors for water heating systems and forced boiler water heat exchangers. Just write us for P-K heating equipment file #126 and we'll send you the set. The Patterson-Kelley Co., Inc., 1106 Warren Street, East Stroudsburg, Pa.

Patterson Kelley

Water Heater Division

storage water heaters • instantaneous heaters • convertors • water to water exchangers

NO BALANCING BOTTLENECK WITH BUENSOD



Shown above is a typical office building Dual Duct layout with individual overhead mixing units in each zone for selective temperature control. Radiation at the exterior walls prevents undesirable down drafts in cold climates and provides heat during night and weekend operation (existing buildings with radiation systems are usually treated in this manner). Changes in mixing units and zone arrangements may readily be made without disturbing the main system. When equipped with pre-set volume regulators, no balancing of units is required on the job site.

Illustrated: Buensod Type H unit designed for overhead installation, generally above hung ceilings. The unit discharges quietly and may be connected to any standard diffuser or grille. Cutaway shows self-contained volume regulator in place.

Tedious, on-the-job adjustment of volume used to be a major bottleneck in the installation of Dual Duct high velocity air systems. Now Buensod air mixing units with Automatic Volume Regulators eliminate that bottleneck. Units are balanced at the factory to specifications. Upon installation they will deliver the pre-determined air volume ±5%. For renovations of existing buildings, this feature permits zones to become operative upon installation of units. There is no need to wait until the entire job is complete.

A simple, tent-shaped apparatus is the heart of this Buensod unit. It automatically maintains constant air quantity, regardless of static pressure variance on mixing valve inlet or outlet. The volume control is completely independent of any sensing instrument, complicated linkage arrangement or outside power source.

Plan on Buensod for your next project.

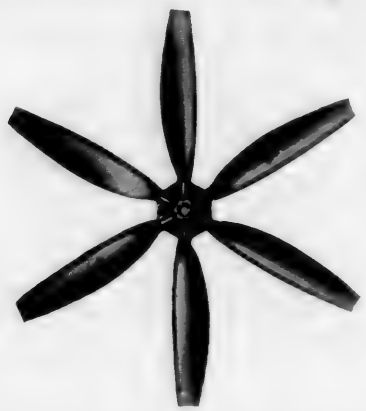
BUENSOD DUAL-DUCT

Write for details to: BUENSOD-STACEY INC. BY-RATED

Buensod-Stacey, Inc., 45 West 18 Street, New York 11, New York

A lot of HOT AIR?

Yes!... half a million cubic feet of it a minute exhausted over glass furnaces by these Hartzell fans



Adjustable pitch fans are cast of corrosion resistant aluminum alloy. Blade pitch adjustment to change air delivery requires simply loosening two bolts. Available in eleven sizes from 40" to 132" — in 3, 4 and 6 blade assemblies.

The exceptionally high air temperature over the glass furnaces in a plant located in New Jersey posed a rather unusual problem for Hartzell engineers. An enormous quantity of 160° air had to be moved very rapidly. The solution was six (two are located on opposite side of monitor) Hartzell 6 bladed 85" fans, each driven by a class "B" insulated 10 H.P. motor — each moving air at 83,000 CFM. High temperature fan belts are used to reduce fan speed to 385 RPM. Motors are all located outside the building, and in such a position that they can be serviced from the roof.

This installation is one of the more unusual ventilation problems that have come up. It points out, however, that each ventilation problem is different — each must be carefully engineered to obtain satisfactory results. Hartzell engineers take pride in having "know-how" to handle any air moving problem. And Hartzell takes equal pride in manufacturing top quality ventilating equipment — both fans and ventilators.

If you have a plant ventilating problem get in touch now with your nearby Hartzell field office. If you don't know where to find it, a note will bring the information at once.

This installation was handled by the Hartzell field office at 333 Arch Street, Camden, New Jersey; phone WOodlawn 4-5256.

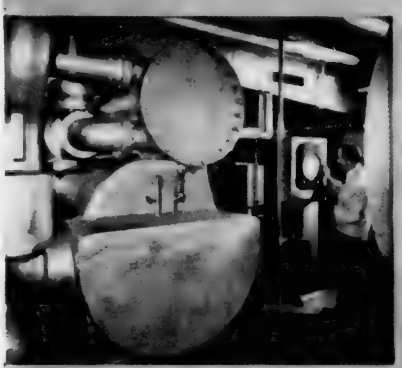
here's a complete line of air moving equipment designed and built specifically for industry

Other famous Hartzell products include controllable and full-feathering propellers for light aircraft, crop drying equipment and farm ventilating fans

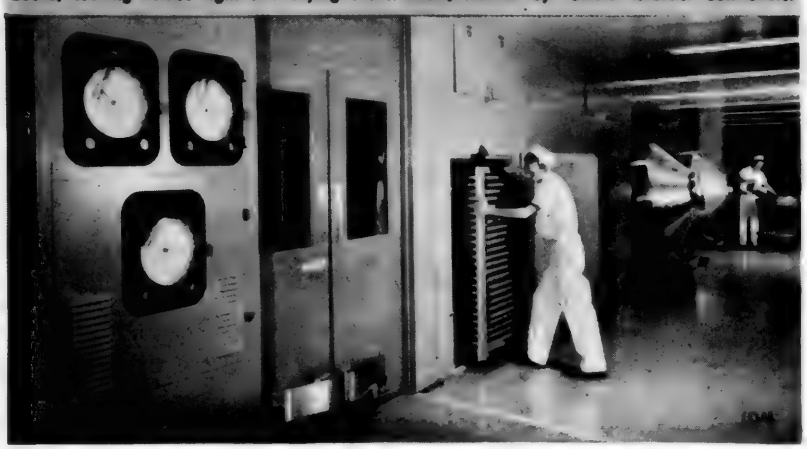
HARTZELL PROPELLER FAN COMPANY • **55 Thomas Blvd. Piqua, Ohio**
Div. of Castle Hills Corp. — A Member of AMCA — Engineering Offices in Principal Cities

Entrance to Stuart Co. pharmaceutical plant, Pasadena, Cal., winner of American Institute of Architects Award. Reflecting pool has planted islands and fountains.

Architect: Edward D. Stone • Mechanical Engineers: Stockly & Bomford
Air Cond. Contractor: Cal-Air Conditioning Co. • Gen. Contr.: Meyers Bros., Brumett & Dambion, Inc.



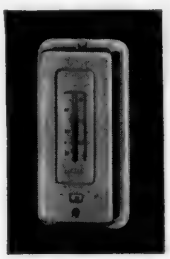
Precise control for refrigeration compressor above, cooking kettles right and drying ovens below, assured by Powers Recorder Controllers.



POWERS

Air Conditioning Control
helps maintain
ideal working climate
and product quality
in Award Winning Plant

Inside this white and gold screened building with its atmosphere of lush splendor is a two story garden court. Surrounding it are balconied executive offices, conference room, library, testing and research laboratories. On the lower level are production and storage areas, dining lounge and swimming pool.



Powers precise temperature and humidity control throughout this fully air conditioned plant provides ideal working climate for comfort, health and efficiency of office and factory employees.

High standards of quality and uniformity are rigidly adhered to in processing Stuart products. Atmosphere in production areas and temperature, humidity and pressure of various processes are accurately regulated by Powers Controlling Recording Instruments.

For Your New Building

be it a school, factory, hospital, church or commercial building ask your architect or engineer to include a Powers Quality system of temperature and humidity control. Its dependable year after year operation and low maintenance cost make it a highly profitable investment.

THE POWERS REGULATOR CO.

Skokie, Ill. • Offices in 85 Cities in U.S. and Canada

Western Offices: Los Angeles, 3200 Temple St. — San Francisco, San Diego, Seattle, Portland, Phoenix, Albuquerque, Denver, Salt Lake City, Billings, Montana. **Texas**—El Paso, Dallas, Houston, Lubbock, San Antonio.

65 years of Temperature and Humidity Control

Perfect air diffusion for electronic computers with ANEMOSTAT AIR DIFFUSERS

High heat return from computer equipment and from high intensity lighting is efficiently controlled by air diffused through scientifically designed Anemostat Air Diffusers.

Anemostat Air Diffusers change the air in a room *once every minute* without a draft. As a result, equipment and technicians operate at peak efficiency in this comfortable thermal environment.

Write for your copy of ANEMOSTAT Selection Manual 60 which contains data on the wide-range ANEMOSTAT line.

ANEMOSTAT®

DRAFTLESS *Aspirating* AIR DIFFUSERS

ANEMOSTAT CORPORATION OF AMERICA

10 East 39th Street, New York 16, N. Y.

Representatives in Principal Cities

. . . don't accept anything less than

SPORLAN Peak Performance SOLENOID VALVES for any Installation . . . *regardless of capacity*

. . . whether for Refrigerants, Water, Steam or Hot Gas Applications

Sturdy take apart construction, few parts, all precision machined to assure positive closing.

All large capacity pilot piston operated Sporlan solenoid valves are equally applicable to Refrigerants 12, 22, and 500.

Sweat type connection valves assembled hand tight, saves valuable time in removing internal parts before installation.

Sporlan introduced synthetic seating over ten years ago to eliminate the possibility of seat leaks.

The famous Sporlan Blue Seal Coils with their high MOPD ratings permit the use of most valves for either Refrigerant 12 or 22.

Just three sizes of Blue Seal Coils fit the complete line of Sporlan solenoid valves.

Color coded lead wires allow quick and easy identification of coil voltage.

See your Sporlan Wholesaler today for complete information and be sure to ask him for Bulletin 30-10

. . . then you'll know why Sporlan Peak Performance means so much on any solenoid valve installation.

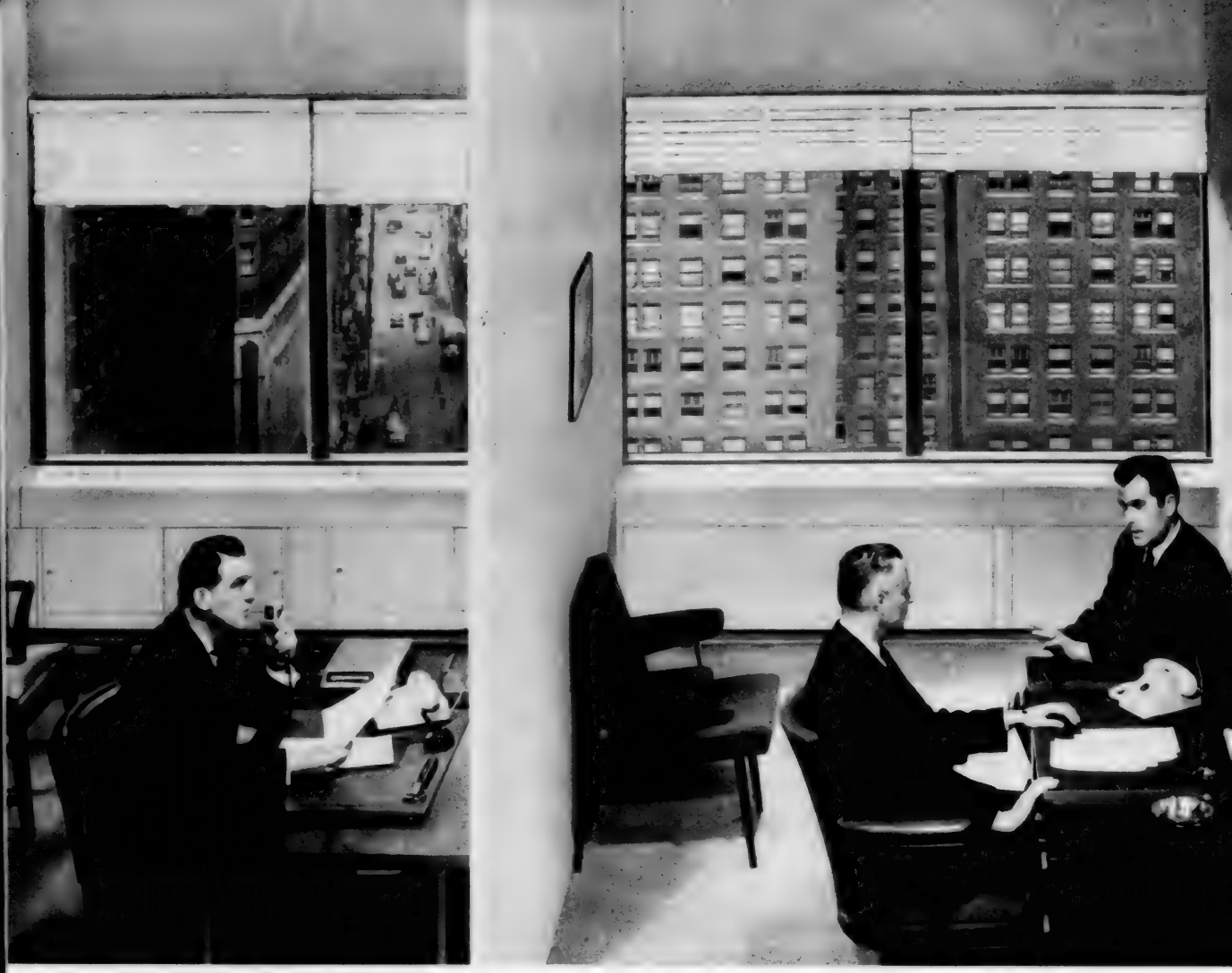
Our 25th Anniversary . . . 1934-1959

Have him explain Right Down the Line Sporlan Peak Performance too!

SPORLAN VALVE COMPANY

7525 SUSSEX AVE. ST. LOUIS 17, MO.

EXPORT DEPT. 85 BROAD ST. NEW YORK 4, N.Y.



Here's how one UniTrane unit (center office) air conditions an entire 24-foot bay. Lateral duct extensions in adjoining offices distribute air from this unit. Components go together quickly, easily, with a minimum of on-the-job fitting.

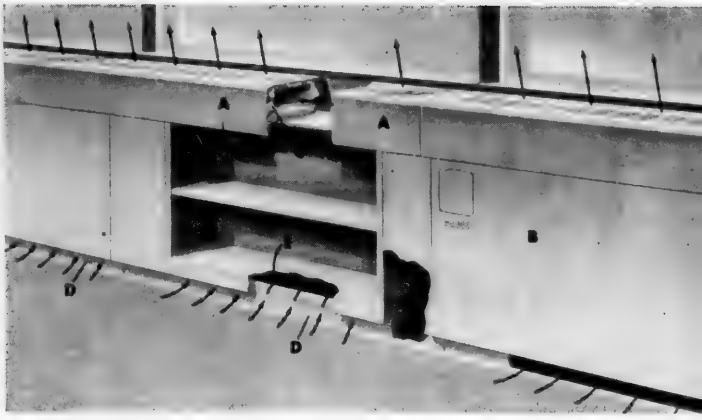
Now! True perimeter with exclusive Trane

Provides a blanket of comfort around building's perimeter—meets changing tenant needs; simplifies installation; cuts piping and control costs

Here is true perimeter air conditioning that meets today's needs for tenant changes—and does it economically. It's the new, exclusive TRANE "Wall-Line" method of air distribution that cuts installation and control costs, makes it easy to meet the varying and changing needs of every building.

Here's how it works:

For example, you install *one* central fan-coil UniTrane Air Conditioner with lateral duct extensions in a twenty-foot bay, instead of three individually controlled units. The extensions distribute conditioned air from the UniTrane unit (cool in summer, warm in winter) all along the outside wall of the bay. And by linking additional fan-coil UniTrane units with winged extensions in adjacent bays or offices, a blanket of comfort is provided around the entire perimeter of the building. There is more flexibility in altering existing walls and partitions—without altering or moving the air conditioning



Conditioned air under pressure rises from plenum extensions (A) and central unit (B)—along entire outside wall. Plenum extensions are heavily insulated (C) to prevent condensation and to reduce noise to an absolute minimum. Return air is drawn through openings at base (D) along the entire installation . . . passes through return air duct (E) to central unit (B).

Check these exclusive Trane features!

- Complete tenant change flexibility at lowest cost.
- Lower installation cost; fewer controls, less piping.
- Quieter operation; air distribution ducts are Fiberglas insulated.
- Custom appearance, attractive shelving, with standard modular units.
- One source for entire operation.

air conditioning "Wall-Line" system !

equipment! In new buildings, there is greater freedom of design than with conventional air conditioning systems: space requirements and floor plans may be worked out *after* the air conditioning has been installed.

Costs are cut because the new TRANE "Wall-Line" system requires fewer individual air conditioning units; in many cases, *one* unit will suffice where *three* would be required with a conventional system. And there is a corresponding saving in controls, piping and installation costs. On-the-job labor is substantially reduced because components are factory-built, ready to install. And this new, improved system provides space for attractive TRANE shelving below the lateral duct extensions. These shelving units enhance the appearance of any office space.

An entirely new concept in big building air conditioning, this new system is available *only* with UniTrane Air Conditioning. For complete facts and specifications, consult your nearby TRANE Sales Office. Or write TRANE, La Crosse, Wisconsin.

For any air condition, turn to

TRANE

MANUFACTURING ENGINEERS OF AIR CONDITIONING, HEATING, VENTILATING AND HEAT TRANSFER EQUIPMENT

THE TRANE COMPANY, LA CROSSE, WIS. • SCRANTON MFG. DIV., SCRANTON, PA.
CLARKSVILLE MFG. DIV., CLARKSVILLE, TENN.
TRANE COMPANY OF CANADA, LIMITED, TORONTO • 100 U.S. AND 19 CANADIAN OFFICES

Contractor and Distributor Reveal:

"Here's why we used 40,000 lbs. of* BRIDGEPORT *Copper Tube"

"When I got the bid on the Encina, California, new high school," says plumbing contractor, Roy V. Anderson of F. L. Anderson Company, "I needed **uniform** top quality in copper water tube. Once I was sure of this, I had to be sure of on-time delivery. If I'm late, you know what happens to my profit and my reputation. But Crane Company always gives me **exactly what** I want in copper water tube and DWV for plumbing, heating and drainage jobs. I've been in this business long enough to know that when I'm backed by a Bridgeport distributor, I can guarantee and deliver on time."

"Right," said Crane's promotional salesman, Jack Richmond, "and Bridgeport distributors are backed by all the technical and engineering help our customers want."

"With Bridgeport's local warehouse stocks," plumbing distributor spokesman, Robert Hencken of the Crane Company of Sacramento, adds, "I know I always can deliver the materials to the contractor when he needs it. Pure and simple, it's a chain in which we're a strong link."

Architect: Satterlee & Tomich
Mechanical Engineer: Lester O'Meara
Plumbing Distributor: Crane Co., Sacramento
Plumbing Contractor: F. L. Anderson Company

BRASS Bridgeport CO.

BRIDGEPORT BRASS COMPANY

BRIDGEPORT 2, CONNECTICUT

Specialists in Metals from Aluminum to Zirconium

How Fafnir Ball Bearings simplify design and assembly for Frick

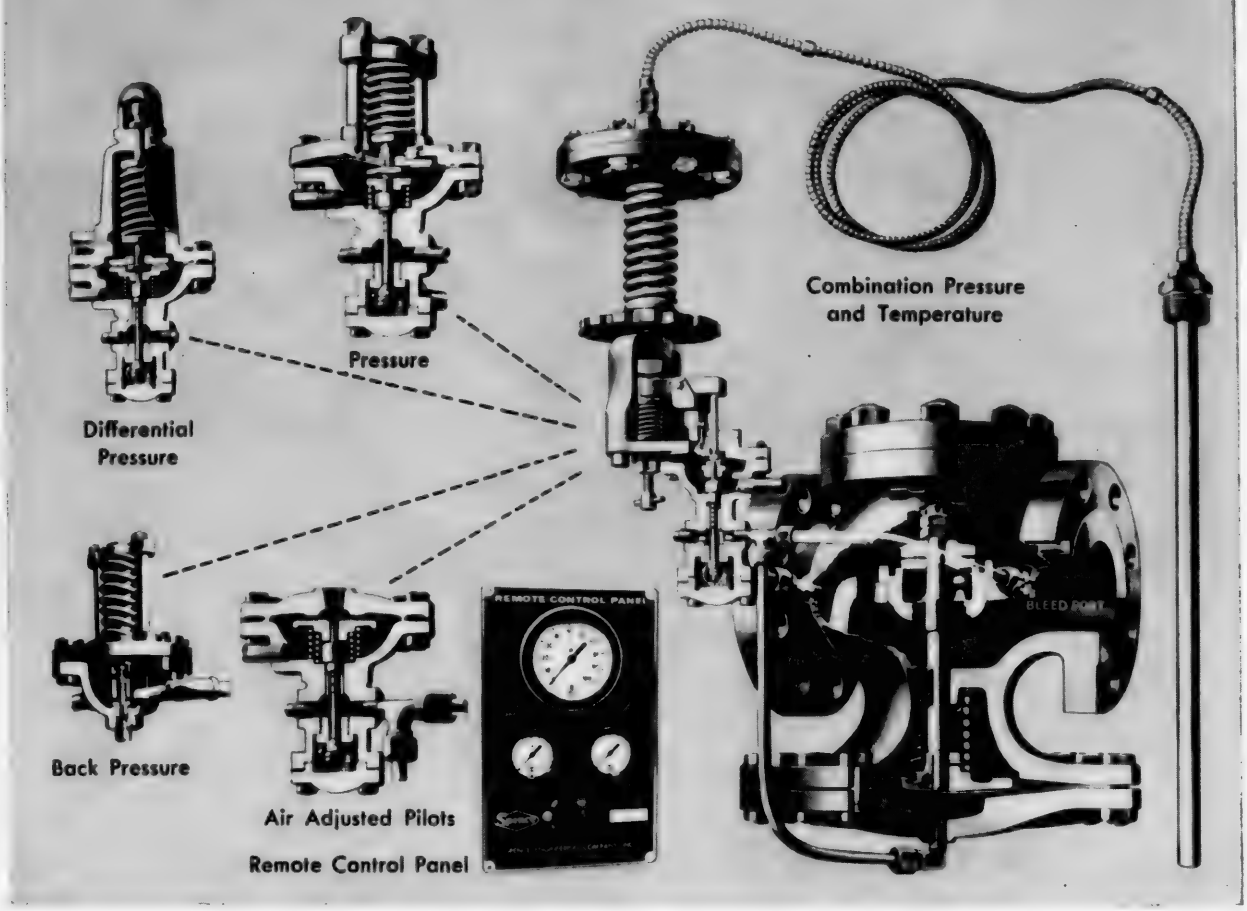
Prefabrication of components and sectional construction permit cost-cutting, job-tailored installations of Frick evaporative condensers (shown at left) and air cooling units (right). Air cooling equipment features "greatest amount of cooling work in smallest space." Frick evaporative condensers can save up to 95% of cooling water where systems do not include spray ponds or cooling towers.

When designing-in fan shaft bearings for their air cooling units and evaporative condensers, Frick Company wanted positive protection against moisture. Fafnir Wide Inner Ring Ball Bearings with Plya-Seals not only afford a built-in answer, but meet several other design needs as well. ✓ ✓ ✓ For example, the patented, contact-type Plya-Seals do double duty. Besides providing the best protection yet against moisture and other contaminants, they also prevent loss of factory-packed lubricant... thus cutting maintenance to a minimum. Assembly costs are cut, too. Bearings slip-fit onto shafts and are locked into place with a twist of Fafnir-originated, eccentric cam design, self-locking collars. No machining, no mounting devices needed. Moreover, wide bearing design assures ample support for the extra-heavy shafts. ✓ ✓ ✓ Such job-right applications make Fafnir a leading supplier of ball bearings for refrigeration, air conditioning, heating, and ventilating equipment. It adds up to experience that can pay off for you! The Fafnir Bearing Company, New Britain, Connecticut.

Fafnir Wide Inner Ring Ball Bearing with Plya-Seals. Flared, Buna-N rubber-impregnated fabric seals ride in constant contact with ground inner ring. Seal back-up shields, mounted in close clearance with inner ring, provide baffle for grease; prevent seal push-in. Bearing is prelubricated, relubricatable.

FAFNIR
BALL BEARINGS

All Pilots Fit All Main Valve Sizes Downtime, Maintenance, Inventory Reduced



Let's start off by admitting there's no such thing as a "maintenance-free" regulating valve. Any valve that automatically controls temperatures or pressures within close limits can be affected by dirt in steam lines.

If trouble does develop, engineers want a regulator they can get back on the line — fast. That's one reason why more engineers are standardizing on Spence Regulating Valves with externally mounted pilots. The simple test of disconnecting the external bends establishes whether the trouble is in the main valve or the pilot.

If the main valve is the trouble spot, it can be maintained without removing the valve body from the line. If the pilot is the trouble spot, it is easily removed for cleaning. However, if production downtime is a strong factor, the fastest method is to install a spare pilot and it is inexpensive.

All Spence pilots fit all sizes of Spence main valves. If you have twenty pressure regulators, for instance, all you need is *one spare pilot*. It will fit all main valve sizes from ¼″ to 12″.

Another advantage of the Spence design is the external pilot is interchangeable. You can change the function of a regulator by merely changing the pilot. In many plants this can represent an important factor in reduced inventory costs because you only carry a few inexpensive extra pilots instead of complete regulators. Obviously, there is also a considerable savings in labor costs when a valve can be converted, in the line, from a temperature regulator to any one of various pressure regulators.

The pictures above show a few of Spence's wide line of automatic regulators. For more information write for Bulletin TE.

SPENCE ENGINEERING COMPANY, INC.
Walden, New York SE-145

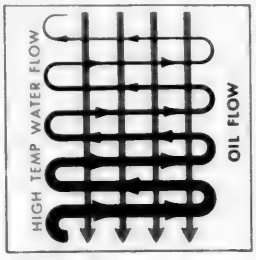
HOW TO USE
high temperature water directly in a no. 6 oil heater–with no danger of system contamination!

The unique Paracoil "Thermo-Film" heater permits *direct use of HTW in the same heater shell with the fuel oil.* The "Thermo-Film" design provides all necessary circuit isolation. This means smaller space requirements, simpler operation and lower installation costs than alternate methods using intermediate exchangers with inter-connecting piping, regulators, level controls, etc.

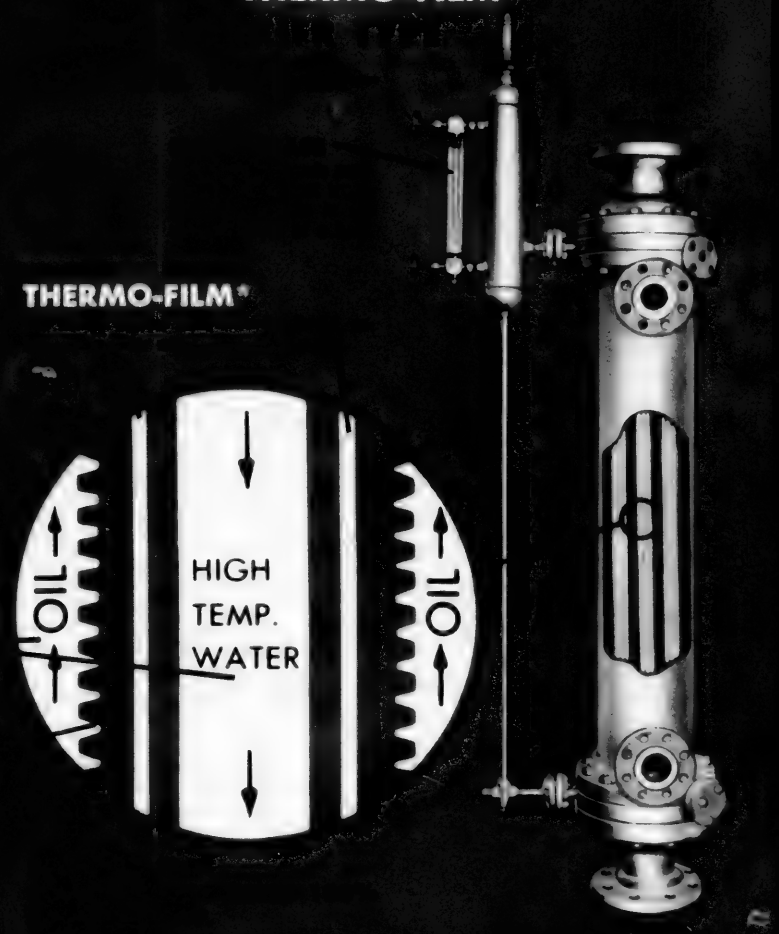
COMPLETE ISOLATION of HTW and fuel oil is accomplished by a coaxial tube assembly, with heat-transfer liquid separating inner and outer tubes. *Boiler contamination in the event of oil tube failure is impossible.*

EXTENDED SURFACE of outer tubes substantially reduces size and weight of heater.

INTERNAL TURBULENCE — with oil baffled back and forth across heating tubes — increases heat transfer rates and reduces bulk of the heater.



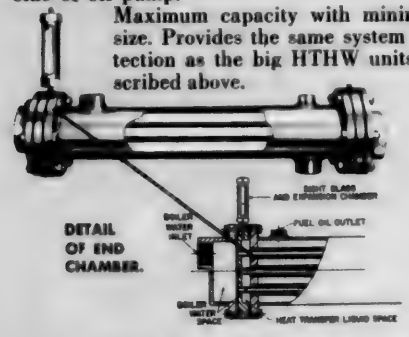
"THERMO-FILM"



DAVIS ENGINEERING

ALSO–LOW PRESSURE MODELS
Compact units using low pressure boiler water, for installation on suction or discharge side of oil pump.

Maximum capacity with minimum size. Provides the same system protection as the big HTHW units described above.



TURN PAGE FOR ADDITIONAL DESIGNS OF PARACOIL FUEL OIL HEATERS — YOU MAY HAVE BEEN LOOKING FOR ONE OF THEM!

Postage Will be Paid by Addressee

No Postage Stamp Necessary If Mailed in the United States

BUSINESS REPLY CARD
First Class Permit No. 1857, Elizabeth, N. J.

DAVIS ENGINEERING
(A Division of American Metal Products Company)
1064 EAST GRAND STREET,
ELIZABETH 4, N. J.

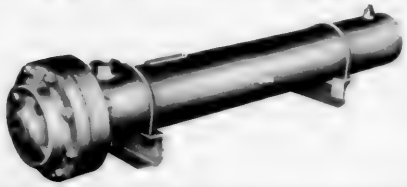
which of these fuel oil heating problems can Paracoil help you solve?

UNDERGROUND STORAGE

INTERMITTENT PLANT OPERATION

HIGH CAPACITY OUTPUT IN LIMITED SPACE

This famous Paracoil Tubular Fuel Oil heater, using steam as the heating medium, provides remarkably high heat transfer rates. Space requirements and weights are at a minimum.



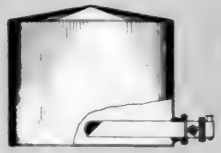
SUB-WATER LINE OR STEAM SYSTEMS

The Paracoil U-Tube type Fuel Oil Heater has been a standard of the fuel oil heating industry for years, can be used for sub-water line or with steam. Features a 6-pass design for the discharge side of the oil pump—a 2-pass design for the suction side.

DAVIS ENGINEERING
(A DIVISION OF AMERICAN METAL PRODUCTS CO.)
1064 EAST GRAND STREET, ELIZABETH 4, N. J.

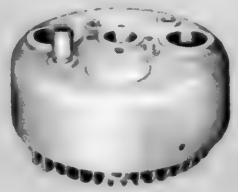
PUMPING VISCOUS NO. 6 OIL FROM STORAGE TANKS

Tank suction heaters are used to lower the viscosity of No. 6 fuel oil before it enters your circulation system. Reduces strain on the pumps. For economy of operation, only the oil being withdrawn is heated—not the entire tank contents.



Tank Suction Bell Heaters

For small-to-moderate demand installations. Easily inserted through standard 16″ tank manhole. Available in two sizes, 6 sq. ft. and 12 sq. ft. heating surface.



Horizontal Tank Suction Heaters

For higher capacity installations. Various designs to suit your own application. Model shown carries flange at inlet end for seal-off valve permitting removal of tube bundle from a full tank.

DAVIS ENGINEERING ACHV
(A DIVISION OF AMERICAN METAL PRODUCTS CO.)

Please send me information and specifications on the following fuel oil heaters:

- ☐ THERMO-FILM HEATERS (see reverse side of this page)
  - ☐ High pressure model
  - ☐ Low pressure model
- ☐ Tank Suction Heaters
- ☐ Tubular Fuel Oil Heaters
- ☐ Type GF Indirect Gas Fired Heater
- ☐ U-Tube Fuel Oil Heaters

My application is_____

Name_____

Title_____ Dept._____

Company_____

Address_____

City_____ State_____

MAIL THIS CARD for information and specifications on any heater shown on this page

QUIET...

ON SMALLEST TO LARGEST *Hydronic** JOBS

B&G circulating pumps, from the 1/12 HP Booster to the new 40 HP Universal are specialized units! They are designed and built specifically to serve the exacting needs of circulated water heating and cooling systems...ideal for applications of the B&G-developed principle of primary and secondary pumping.

Quiet, vibrationless operation is the outstanding characteristic of B&G pumps. They can be installed without expensive flexible connections or noise dampeners of any kind.

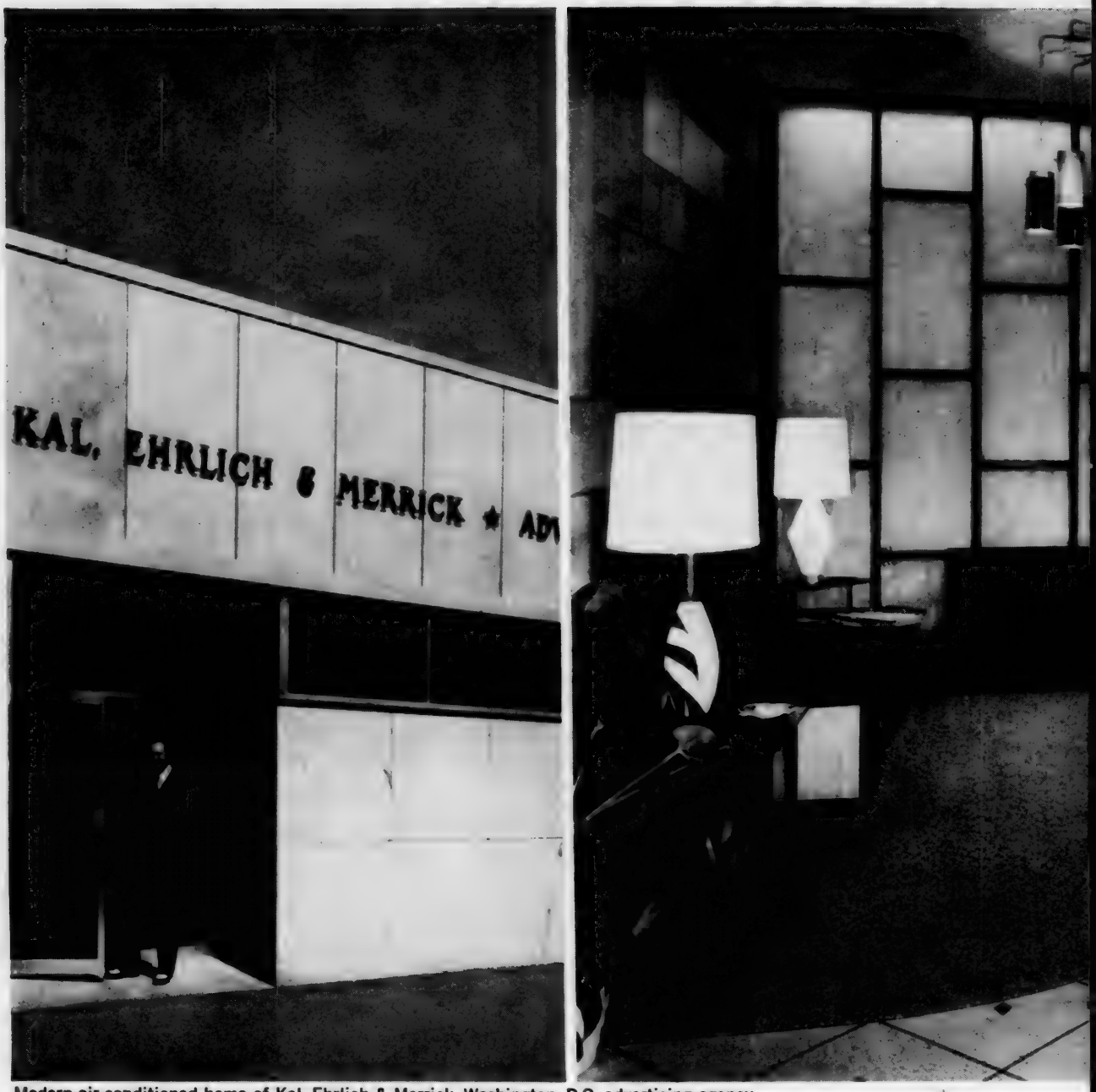
Among the features which assure both quiet operation and long-lived dependability are specially built, more costly motors, tested for quietness—oversized shafts of hardened alloy steel—long sleeve bearings—noise dampening spring couplers—oil lubrication and leak-proof mechanical seals.

That's why B&G Circulating Pumps, small or large, are *preferred* ...they're *quiet where silence is a "must"!*

Hydronics: The science of heating and cooling with water.

BELL & GOSSETT
COMPANY
Dept. FT-4, Morton Grove, Ill.

Canadian Licensee: S.A. Armstrong, Ltd., 1400 O'Connor Drive, Toronto, Ontario



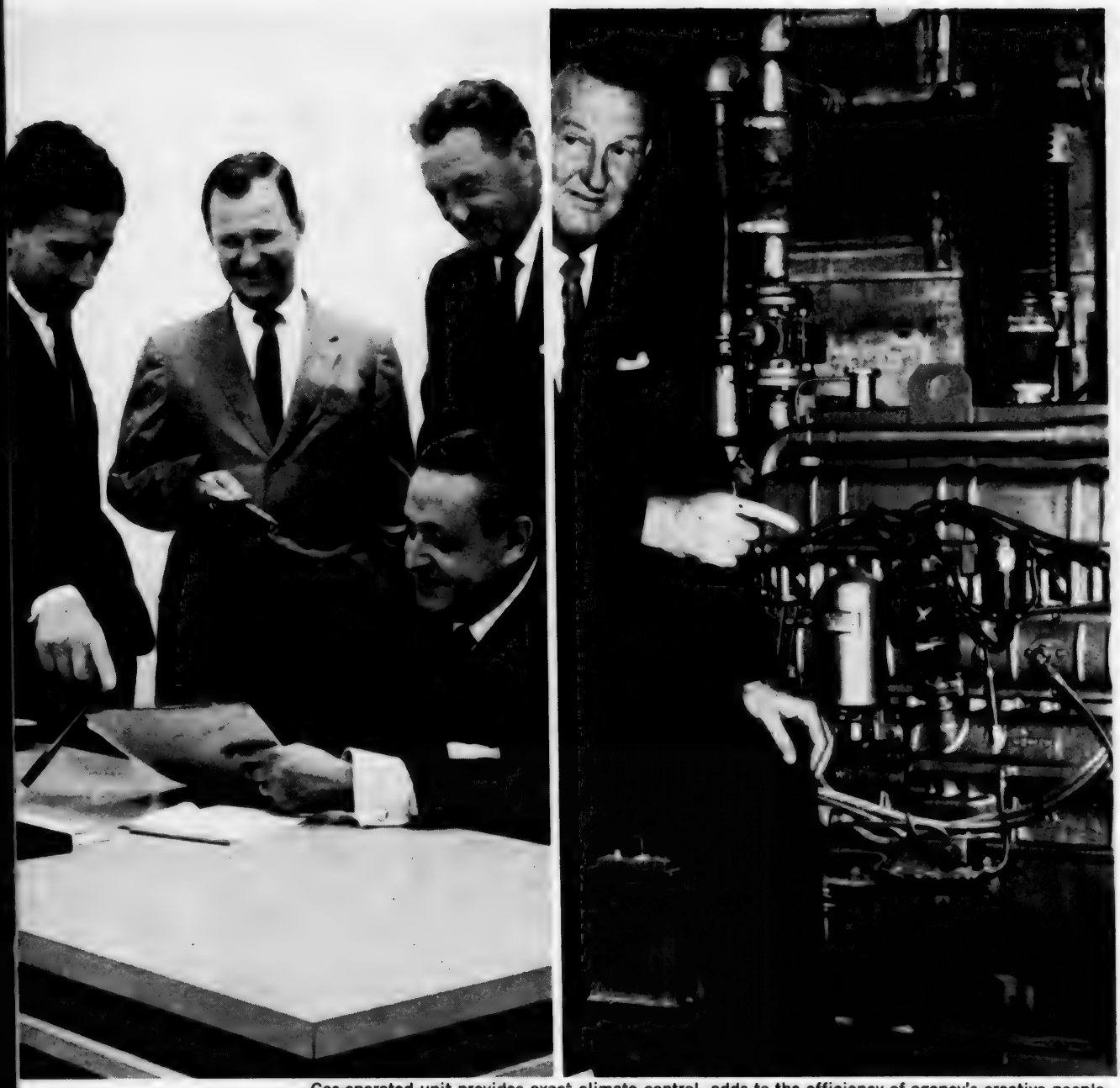
Modern air-conditioned home of Kal, Ehrlich & Merrick, Washington, D.C. advertising agency

"Nothing to do—but enjoy it, with our all-

Says Harry L. Merrick, Sr. President,
Kal, Ehrlich & Merrick Advertising Agency

"Only the best air conditioning system would do for our new building, and experience proves the best is definitely gas", continues Mr. Merrick. "Our Ready-Power air conditioner gives us the exact climate control we want every day of the year . . . and it's extremely inexpensive to operate."

Ready-Power's exclusive variable speed operation offers *constant, precise* control of humidity and temperature without the variations common to on-off systems.



Gas-operated unit provides exact climate control, adds to the efficiency of agency's creative people.

year READY-POWER GAS air-conditioning!"

Because they combine the outstanding economy of gas fuel with automatic metering to match the load on hand, Ready-Power units have the lowest known operating costs . . . *less than a penny per ton per hour!*

For information on how you can benefit by installing modern Gas air conditioning equipment, call your Gas Company's commercial specialist or write to the Ready-Power Company, Detroit 14, Michigan. *American Gas Association.*

Underground Heat Distribution Systems

How To Protect A System Against Failure

Specifications are the *only* way a designing mechanical engineer can be assured the final project will have met his required standards and be of the quality the owner bought.

Three major elements make up an underground heat distribution system: an inner pipe to convey steam, high temperature hot water, chilled water, condensate, etc., (type and size depending upon project requirements); the insulating of the inner pipe to minimize heat loss; and the outer casing to protect the insulation and inner pipe.

The outer casing has to be specified in such a way that it will provide positive protection against moisture entrance and accumulation. Saturated insulation, of course, equals low efficiency. Moisture, present constantly in buried pipe, accelerates corrosive action which is amplified in acidic and electrolytic soils.

Testing welded joints by applying a soap solution with the casing under 25 p.s.i.g.

To be positively leak tight the casing must be tested air tight. The engineer should specify a 25 p.s.i.g. air test on the casting for two consecutive hours without a drop in pressure.

In order to prevent accumulation of moisture, the casing should be specified with a smooth interior.

Impact from above and earth back fill weight is a problem the engineer resolves by specifying a 14 gauge steel casing with a spiral lockseam for added crush resistance.

Now knowing that his casing is impact and water proof he protects the casing by specifying an anti-corrosive compound that will withstand a 15,000 volt spark test and have a permeability of .05 perms or less.

With the casing and joints sealed leak tight and protected against electrolysis and sub-soil acids he needs only one bit of . . .

Final Protection

Any system should be selected with this thought in mind:

"That some moisture will find a way into the system such as a rain storm prior to installation."

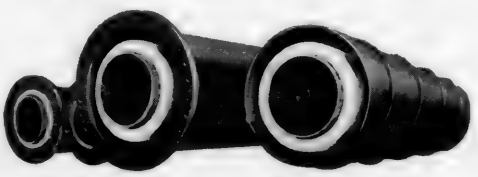
Therefore, to protect the system against any moisture that may get inside prior to final assembly, he specifies "that an annular uninterrupted air space must run the entire length of the system." With this feature and openings at ends of casing for draining and venting, he can force ventilate the system and dry it out. By necessity, the insulation must, of course, have an insoluble binder and be capable of returning to its original insulating efficiency when dry, even after a thorough saturation.

For a free 24 page catalog with facts and figures for designing and specifying underground heat distribution systems, write: E. B. Kaiser Co., 2114 W. Lake Ave., P. O. Box 47, Glenview, Illinois.

". . . for highest quality"

EBKO

PIPING SYSTEMS



But it takes more than a sign to stop low water . . .

. . . and the hazards that can accompany a low water condition in both a steam and hot water heating boiler.

We are all agreed that our schools must be made as safe as possible. With schools so crowded today and facilities overtaxed, there is greater need for vigilance than ever before.

One thing you can do is to see that the boiler water line is under the endless vigil of McDonnell boiler water level controls. Low water can strike anywhere, for any of a score or more reasons, bringing with it the threat of serious and costly damage. And make no mistake about this: Low water is just as much of a possibility in hot water boilers as in steam boilers.

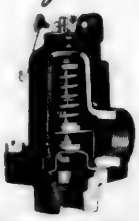
For the average school heating boiler, McDonnell Feeder Cut-off Combinations are a simple, time-proved answer. They add water automatically when needed to maintain a safe water level in the boiler, then stand by to stop the burner if any emergency condition drops the water line to a dangerous level. There is nothing better available for the vital task of protecting a boiler against hazardous low water.

Right now is the time to act. Your local school board must rely on you to bring it to their attention. You'll be doing your community even a bigger favor than you do yourself.

McDONNELL & MILLER, *Inc.*, 3500 N. Spaulding Ave., Chicago 18, Ill.

Doing One Thing Well

No. 51-2, the Boiler Water Feeder and Low Water Cut-off combination that fits most school jobs. For steam and hot water space heating boilers. Other combinations to fit all boilers.



230 SeriesPressure Relief Valves for hot water space heating boilers. Meet ASME Boiler Code in every respect; rated and certified by the National Board.

No. 150 Pump Control, Cut-off and Alarm Switch. For boilers up to 150 lbs. The most widely used, time-proved control of its type. Also available with integral water column, as No. 157.

McDONNELL *Boiler Water Level Controls*

BRONZE WALL PLAQUE READS IN PART—

NATIONAL HISTORIC SITE
TOURO SYNAGOGUE of
Joshuat Israel Congregation
Founded 1658

This oldest synagogue building in the United States was designed by Peter Harrison. Ground was broken August 1, 1759. It was dedicated on December 2, 1763. Here, in 1781-84, the Rhode Island General Assembly met and during Washington's visit to Newport in 1781, a town meeting was held here. The State Supreme Court held sessions here at that period.

The building was re-opened for religious services on August 2, 1850.

NATIONAL PARK SERVICE
U. S. Department of Interior

OLDEST SYNAGOGUE IN AMERICA SELECTS MODERN WEIL-McLAIN BOILER IN RESTORATION PROGRAM

Capacities:
Hot Water, 339,100—793,700 BTU/hr.
Steam, 1415—3305 sq. ft.

Touro Synagogue, in Newport, Rhode Island, is listed as a national historical site. Erected in 1763, it is currently undergoing an extensive restoration program.

A Weil-McLain No. 82 Oil-fired Boiler with a net I=B=R rating of 1580 sq. ft. of steam was selected to replace the old boiler—a selection dictated by the many advantages of this modern *cast iron* boiler.

In the No. 82 Boiler, the exclusive Weil-McLain design of those parts which contribute to efficient combustion of fuel and absorption of heat is an assurance of economical operation. For units burning seven or more gallons per hour, Weil-McLain provides an electronic primary safety control to prove the flame. Easy assembly with short draw-rods and new asbestos rope seal reduces erection costs.

A special feature of the No. 82 is the provision made for single or double domestic water heaters. Dual heaters offer a choice of three advantages: (1) increased volume of hot water, (2) hot water at two different temperatures, (3) one heater to be used for snow melting.

Send for bulletin C-270. For other Weil-McLain Gas and Oil boilers see Engineers' Product File or Sweet's Architectural File.

Architect: Gerald R. Watland, New York, N. Y.
Consulting Engineers: Hankins and Anderson, Richmond, Va.
Heating Contractors: H. W. McPherson & Sons, Newport, Rhode Island
Distributor: Corcoran Supply Co., Fall River, Massachusetts

WEIL-McLAIN

NO. 82 OIL-FIRED BOILER AND OIL HEATING UNIT

WEIL-McLAIN BOILERS · RADIATORS

WEIL-McLAIN COMPANY
MICHIGAN CITY, INDIANA

Address literature requests to Dept. BB-69

They compared "K" factors and cost factors . . . and bought G-B SNAP*ON®

Compare insulations for plant piping jobs, for example — and you will agree that for economy, performance, and thermal efficiency, there is *nothing* like G-B Snap*On, the original one-piece pipe insulation molded of fine glass fibers. It's far cheaper to apply under all plant conditions—crowded quarters . . . long straight lines . . . hot or cold piping that involves numerous bends, valves, and obstructions. And G-B Snap*On is the only one-piece insulation available in a complete range of sizes from copper tubing to 36″, plain or with jackets. But see for yourself—ask your local G-B distributor to make a TEVA (Thermo-Economic Value Analysis) survey so you can compare "K" factors and cost factors as they apply to your own insulating jobs.

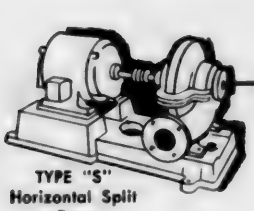
FOR FREE TEVA SURVEY CALL YOUR LOCAL G-B SNAP*ON DISTRIBUTOR
LISTED IN YELLOW PAGES

GUSTIN-BACON *Manufacturing Co*

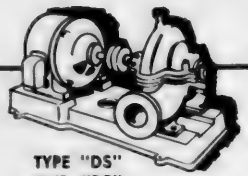
222 W. 10th St., Kansas City, Mo.

Thermal and acoustical glass fiber insulations . . . molded glass fiber pipe insulation
Couplings and fittings for plain and grooved end pipe

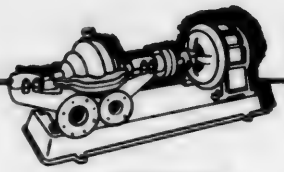
BETTER LIVING AND WORKING THROUGH



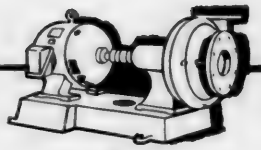
TYPE "S"
Horizontal Split
Case



TYPE "DS"
AND "DP"
Horizontal Split
Case



MULTISTAGE
Horizontal Split
Case



TYPE "FC"
Flexible Coupled

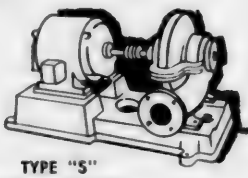
"from Chicago"

PUMPS FOR *EVERY* BUILDING SERVICE . . . SINCE 1909

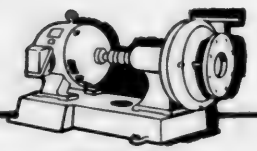
"Chicago" Pumps provide *reliable* pumping service for commercial, industrial and institutional buildings throughout the world. Fifty years of manufacturing experience and engineering know-how are incorporated in every unit . . . assuring highest quality, operating economy and years of trouble-free service.

New and improved models and expanded sizes have been introduced nearly every year since 1909 . . . until today when engineers are able to specify "Chicago" Pumps for most building applications. Important recent additions to our pump product line include the SEALTRODE* Sealed Electrode Floatless Pump Controller and the IMMERSIPUMP* Submersible Non-Clog Sewage and Sump Pump. The most popular units are the exclusive FLUSH KLEEN® Clog-Proof Sewage Pumps . . . greatly improved in 1959 with important new features.

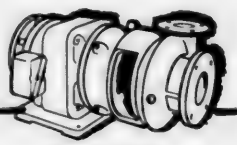
*Trademark



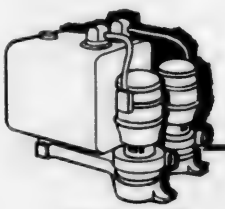
TYPE "S"
Horizontal Split
Case



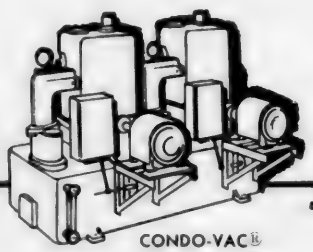
TYPE "FC"
Flexible Coupled



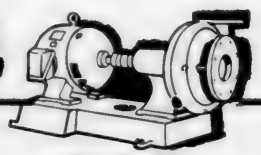
TYPE "CC"
Close Coupled



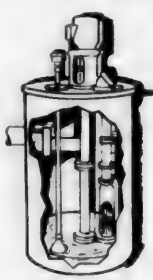
SURE RETURN®
CONDENSATE



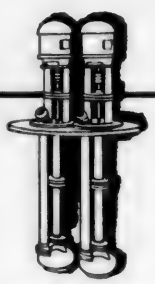
CONDO-VAC®
Boiler Feed &
Vacuum



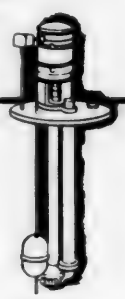
TYPE "FC"
Flexible Coupled



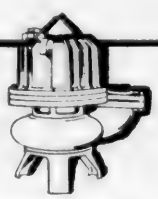
TYPE "F"
FLUSH KLEEN®
Clog Proof
Sewage



VCS NON-CLOG
Sewage



LGL2 Sump

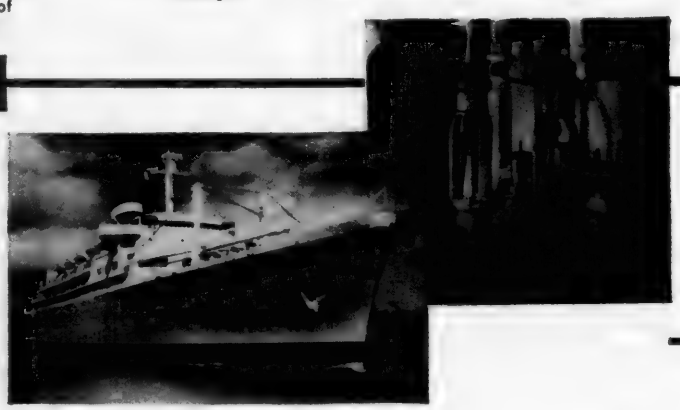


IMMERSIPUMP*
Submersible
Sewage & Sump

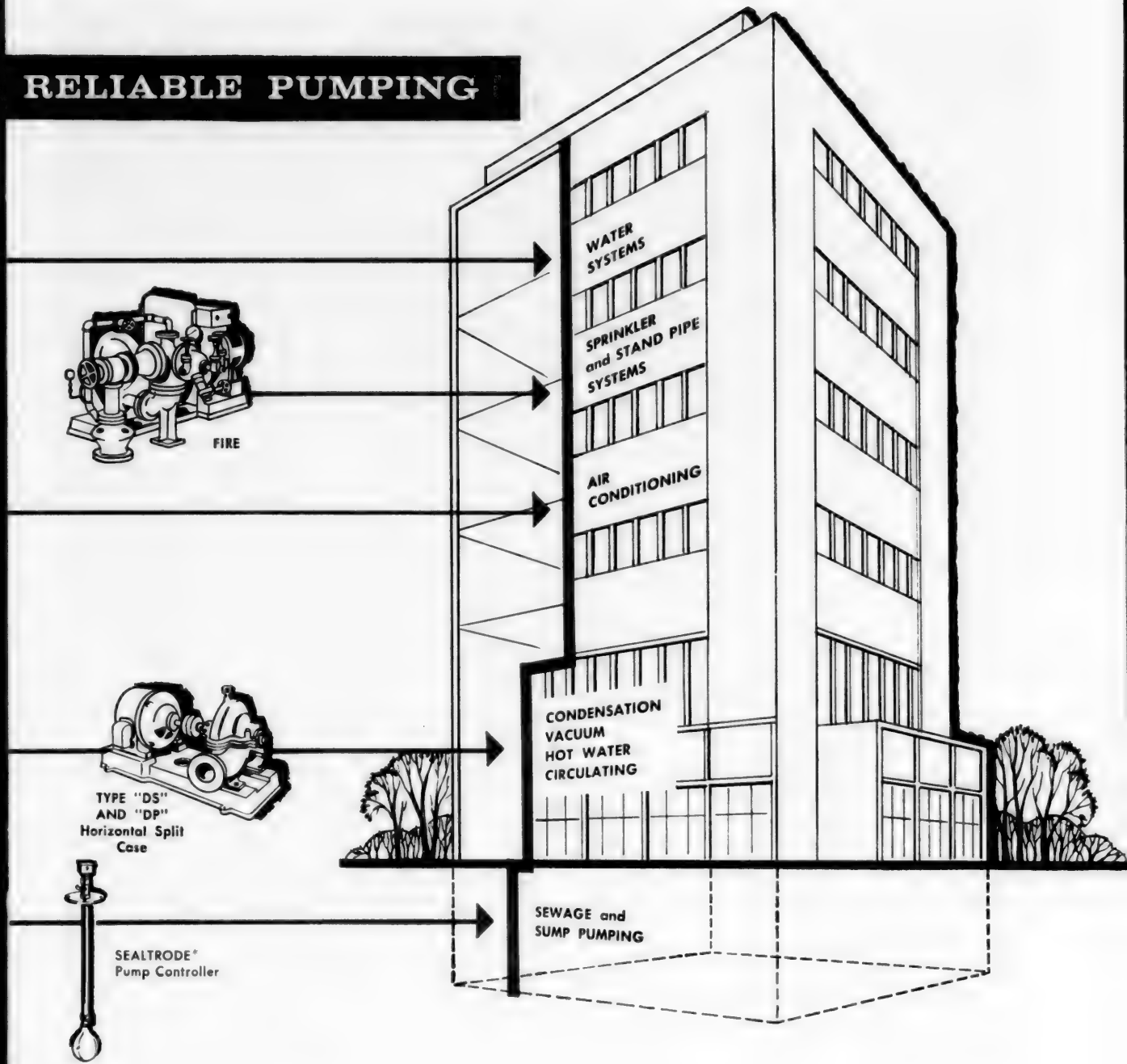
MARINE PUMPS

"Chicago" sewage pumps served during World War II . . . on hundreds of troop, transport, and supply ships. They serve in peacetime too . . . in ships of the Maritime Commission. Wherever you go . . . on land, or over the seas . . . "Chicago" pumps go too!

"Chicago" FLUSH KLEEN® Clog-Proof Sewage Pumps aboard the S. S. Santa Paula



RELIABLE PUMPING



Putting Ideas to Work

FOOD MACHINERY AND CHEMICAL CORPORATION

Chicago Pump Company

622J DIVERSEY PARKWAY • CHICAGO 14, ILLINOIS

1909 50 YEARS 1959 CHICAGO PUMP COMPANY

© 1959—CPCo-FMC

5 SIZES EACH

only 8½" thin

4 new thin-line design INDIVIDUAL ROOM SEASONMAKERS...

These McQuay thin-line design Seasonmaker individual room air conditioning units are only 8½ inches thin and 25 inches high or deep, and offer you more compact, modern styling, requiring a minimum of installation space.

There are four models—each in five sizes, 220, 330, 440, 520 and 640 cfm. The four smaller sizes are equipped with 1050 rpm motors, while the largest has 1500 rpm. Hand-of-coil connections are easily reversed in the field. Filters are changeable without removing decorative panels.

All McQuay Seasonmakers are ultra-quiet in operation and furnish individual room comfort at any desired temperature level. They are quick and easy to install and service, and ideal for multi-room buildings such as hotels, motels, schools, hospitals, offices and residences. Call the McQuay representative in or near your city for complete information about these new thin-line design Seasonmakers, or write McQuay, Inc., 1619 Broadway Street N. E., Minneapolis 13, Minnesota.

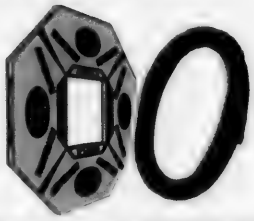
McQuay INC.

AIR CONDITIONING • HEATING • REFRIGERATION

IN TUBING, Nothing Beats Copper! IN COPPER TUBING, Nothing Beats READING!

For COPPER WATER TUBE

Specify READING "LEKTRONEAL"®



For COPPER REFRIGERATION TUBE

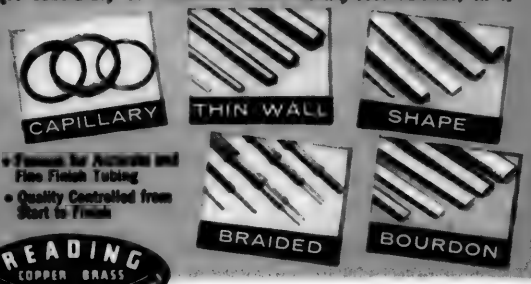
Specify READING "LEKTROSEAL"®

Also Specify READING for–

- COMMERCIAL COPPER TUBE
- RED BRASS & COPPER PIPE
- THREADLESS COPPER PIPE

For PRECISION COPPER TUBE Specify MACKENZIE WALTON

(A Subsidiary of READING TUBE CORP.) PAWTUCKET, R. I.



- Famous for Accurate and Fine Finish Tubing
- Quality Controlled from Start to Finish

For FINNED COPPER TUBE Specify READI-FIN®

READI-FIN TYPE W/H

A line of heat transfer tubing made by Readi-Fin Mfg. Co., Inc. (a subsidiary of Reading Tube Corp., at Reading, Pa.). The extended surface is extruded from the tube wall, thus eliminating the possibility of fin failures resulting from thermal shock, corrosion and erosion. This "one-piece" (integral) construction provides maximum heat transfer efficiency, ruggedness, easy fabrication and freedom from fouling. It's available in Water Tube types with finned or plain ends and in Condenser Tube types with finned, plain or stripped ends.

MADE IN U.S.A. TO THE STANDARDS OF AMERICAN INDUSTRY

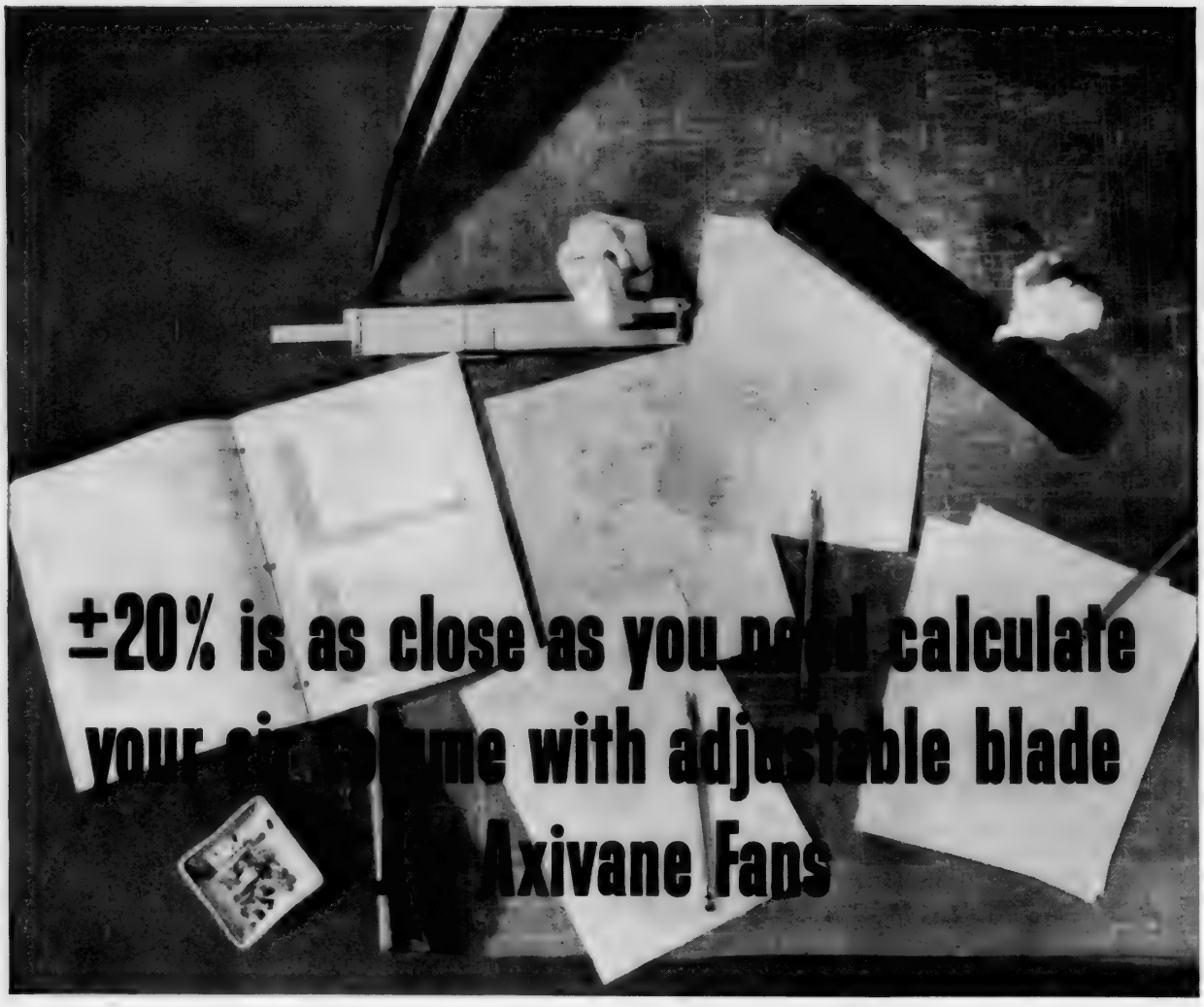
READING TUBE CORPORATION

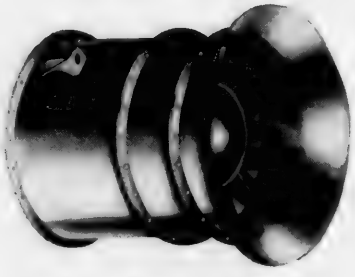
Empire State Building, New York 1, N. Y., Plant: Reading, Pa.

Distribution Depots:

READING, PA.	**WOODSIDE, L. I., N.Y.** 57-17 Northern Blvd.	**PHILADELPHIA, PA.** 921 Penn St.	**CHICAGO, ILL.** 305 W. 31st St.	**CLEVELAND, OHIO** 4615 Perkins Ave.
ATLANTA, GA. 690 Murphy Ave. S.W., Unit 5, Bldg. B	**OAKLAND, CALIF.** 410 Hegenberger Rd.	**LOS ANGELES, CALIF.** 120 No. Santa Fe Ave.	**DENVER, COLO.** 2845 Walnut St.	**HOUSTON, TEXAS** 1121 Rothwell St.

DALLAS, TEXAS—9000 Sovereign Row, Brook Hollow Industrial District





Ask for Bulletin 290-40.

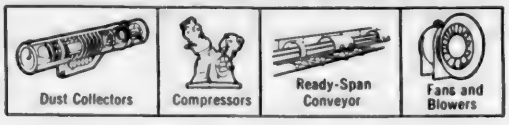
Computation of air volumes required for ventilation can be greatly simplified by installing Joy Axivane Fans. Standard models are furnished with adjustable blades which can be rotated to change pitch, and consequently volume, over a considerable range. This permits compensating for circumstances unforeseen when air requirements were computed, and also allows the installation of fans which will be able to efficiently supply additional air for pre-planned expansions of the plant. Blade adjustments can be made by anyone in a matter of minutes. Calibrated scales on hub and blades assure accurate matching of blade pitches.

Joy Axivane Fans are designed with integral motors to permit in-duct installation. This reduces installation costs, and saves space. The fans are available in a wide range of sizes for every type of duty, and can be furnished in special materials for use in corrosive atmospheres.

Whatever your fan requirements may be, Joy has the answer.

WSW I 7483-290

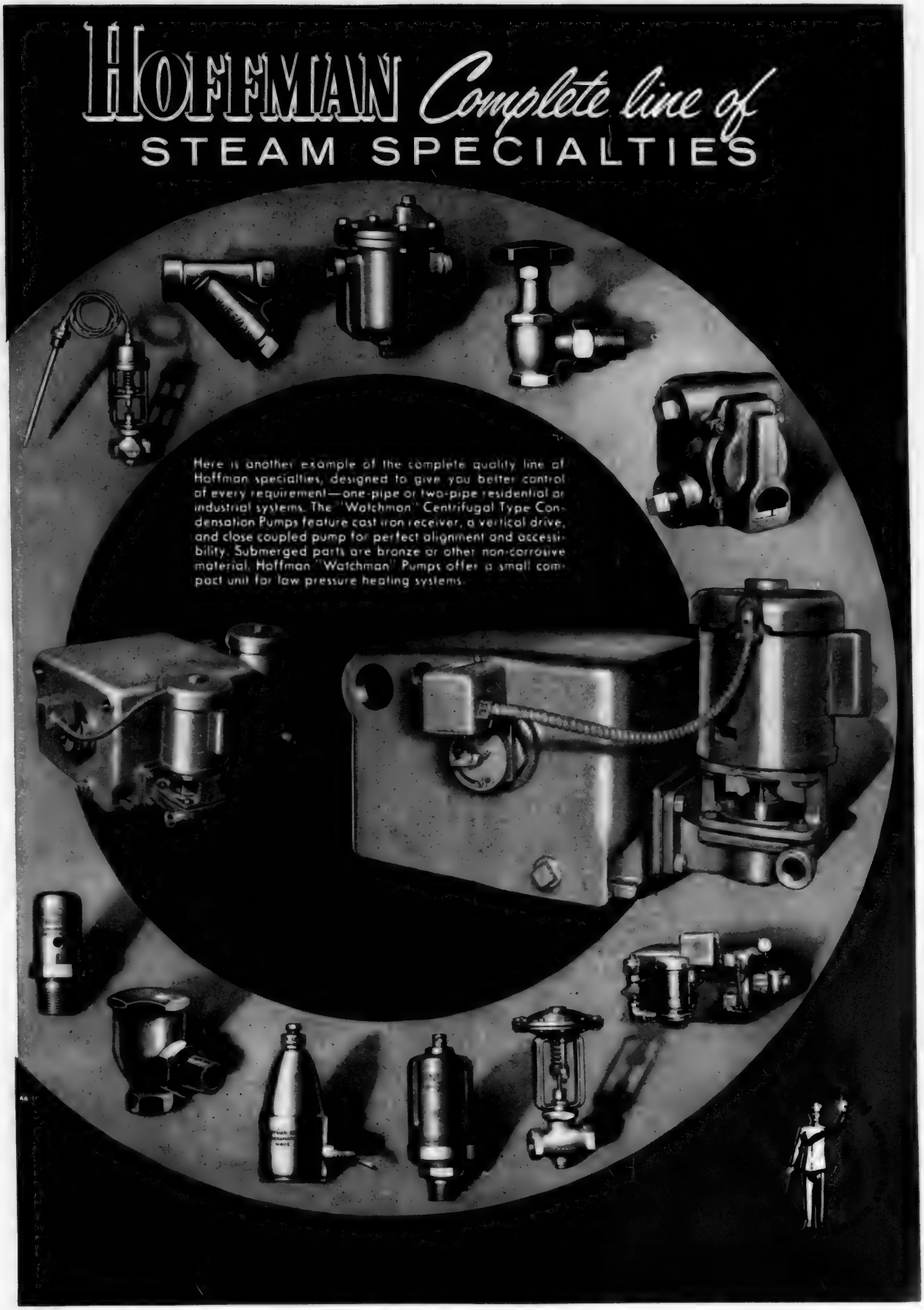
AIR MOVING EQUIPMENT FOR ALL INDUSTRY



JOY

Joy Manufacturing Company
Oliver Building, Pittsburgh 22, Pa.

In Canada: Joy Manufacturing Company (Canada) Limited, Galt, Ontario


HOFFMAN Complete line of
STEAM SPECIALTIES
Here is another example of the complete quality line of Hoffman specialties, designed to give you better control of every requirement—one-pipe or two-pipe residential or industrial systems. The "Watchman" Centrifugal Type Condensation Pumps feature cast iron receiver, a vertical drive, and close coupled pump for perfect alignment and accessibility. Submerged parts are bronze or other non-corrosive material. Hoffman "Watchman" Pumps offer a small compact unit for low pressure heating systems.

...with NIBCO copper fittings

Residents of Denver couldn't believe their eyes as they watched the Alida Rae Apartment building start to go up. The foundations were hardly in place before the plumbing lines were installed.

There was no error. Joe Harris of Harris & Company Plumbing was merely using a new technique, worked out with S. W. Haan, the architect/engineer, to save space, time and money.

With NIBCO fittings from Amstan Supply, Harris employees (members of Denver Plumbers' Local #3) prefabricated a copper system for this three-story building at the shop, hauled it to location and set it up. With no bother, no fuss, they completed the entire plumbing in three trips to the site: (1) Laid underground lines; (2) Set the prefabricated "trees"; (3) Set the fixtures.

If you are interested in more details, write
NIBCO INC., Dept. J- 6306, Elkhart, Indiana

SEND FOR FREE DRAINAGE CATALOG DWV-2

NIBCO

HUSKY

Husky fittings conform in all respects to the following high standards set forth by the American Society For Testing Materials: A 234-58T.

- ✓ PROCESS AND MATERIAL
- ✓ MANUFACTURE
- ✓ CHEMICAL COMPOSITION
- ✓ HEAT TREATMENT
- ✓ TENSILE PROPERTIES
- ✓ HARDNESS
- ✓ WORKMANSHIP AND FINISH
- ✓ MARKING
- ✓ INSPECTION

Learn why Husky fittings are "7 Ways Better" . . . send coupon.

HUSKY
WELDING FITTINGS

SEND FOR CATALOG OF HUSKY STEEL WELDING FITTINGS

NIBCO INC., DEPT. JS-6306, Elkhart, Indiana

Please send your new Husky Catalog H-1 without cost or obligation.

name _____

firm _____

address _____

city, state _____

☐ Please also send address of nearest supplier.

You get these benefits when you install YARWAY GUN-PAKT EXPANSION JOINTS

Why do industrial plants, institutions, universities and central heating plants SPECIFY and INSTALL Yarway Gun-Pakt Expansion Joints?

Because with Yarway you get:

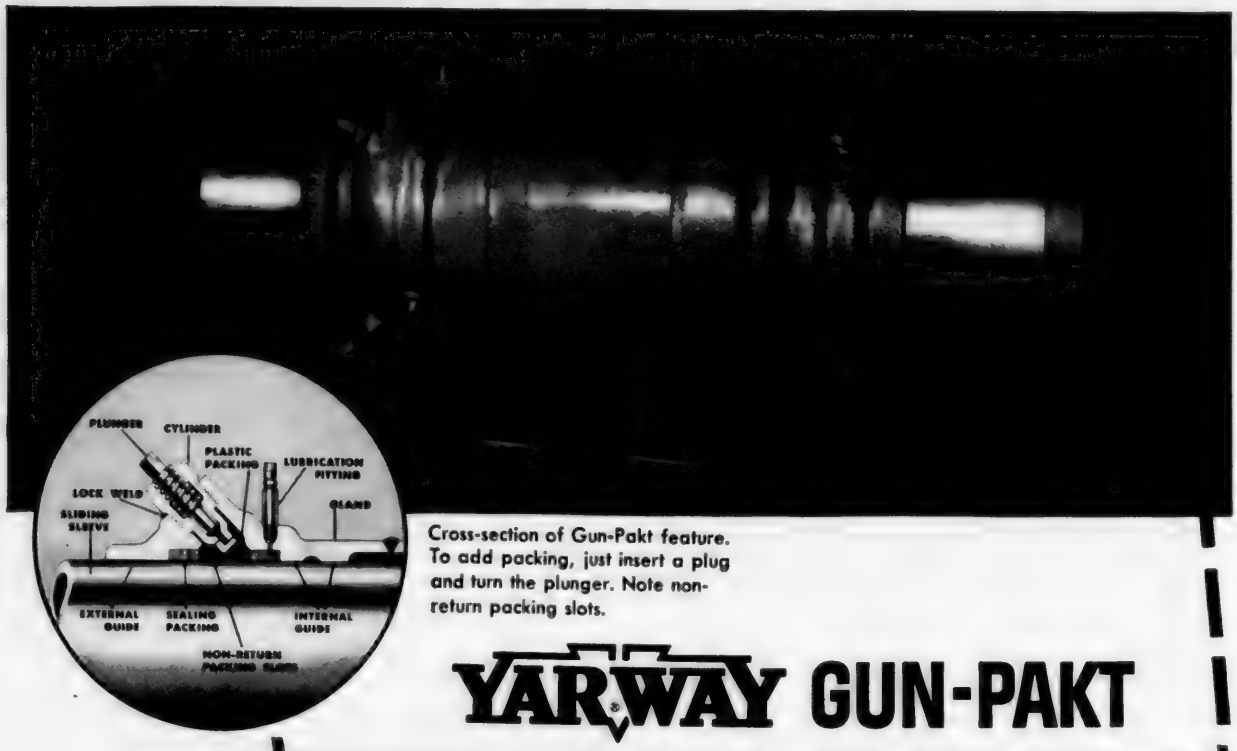
- **CONTINUOUS SERVICE**
  Costly shutdowns are eliminated. Packing is seldom necessary but may be added *under full line pressure*. No vents are necessary. Never needs repacking.
- **RUGGED DEPENDABILITY ALL STEEL CONSTRUCTION**
  Durable chromium plated seamless steel sleeves. No chance *of metal fatigue*. Wrought steel bases provide rugged, positive anchorage.
- **INTERNAL AND EXTERNAL GUIDES**
  Positive alignment of sleeve in stuffing box *—where it counts!*
- **LIGHT WEIGHT, STREAMLINED DESIGN**
  Requires less space to install—less space to maintain—smaller manholes.

Many Gun-Pakt joints have been *in service over 25 years with only nominal maintenance*—no major repairs or periodic overhauls. Maintenance costs are negligible—records show average to be one manhour and 65 cents worth of packing per joint per year. AND—NEVER A SHUTDOWN FOR REPACKING!

YARWAY field engineers are qualified to advise on installation and service—at no cost to you. Investigate today. Write for Bulletin EJ 1917 ('59).

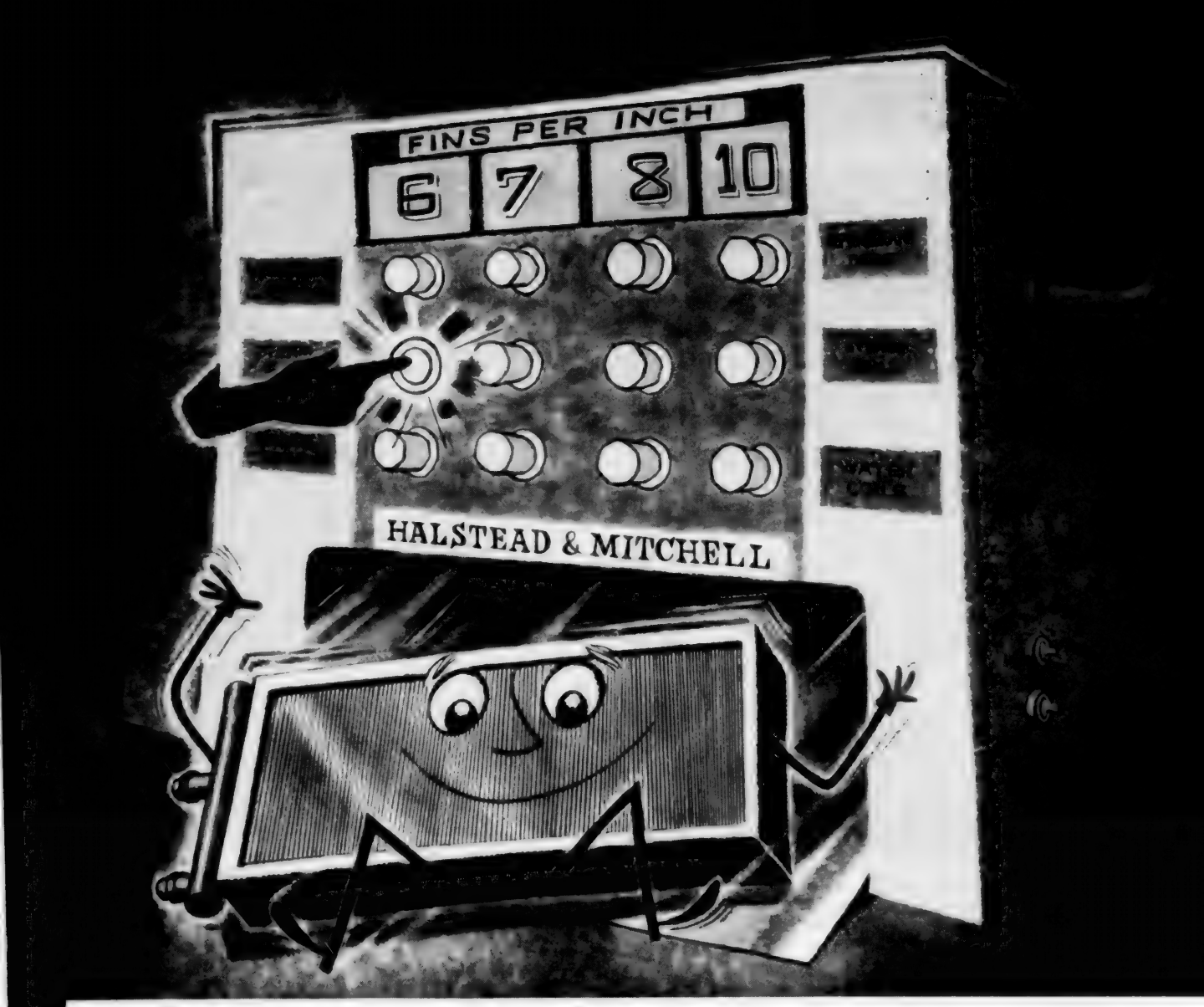
FOR YOUR NEXT PIPELINE JOB—BE SAFE—BE SURE! SPECIFY YARWAY GUN-PAKT.

YARNALL-WARING COMPANY
104 Mermaid Avenue, Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES



Cross-section of Gun-Pakt feature. To add packing, just insert a plug and turn the plunger. Note non-return packing slots.

YARWAY GUN-PAKT



BEFORE YOU BUY, THINK:

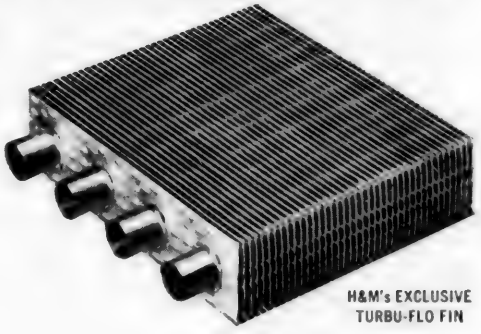
Do you need 6, 7, 8 or 10 fins per inch?

Halstead & Mitchell supplies Turbu-Flo Coils with the fin spacing you want

Why accept someone else's "standard" when your own judgment dictates another fin spacing for the specific job at hand. Now you can call on Halstead & Mitchell for Turbu-Flo coils with 6, 7, 8 or 10 fins per inch to meet your individual size requirements.

H&M makes coils for use with most refrigerants, steam (standard or non-freeze coils), hot or chilled water. All coils are available from 1 to 8 rows deep, with finned heights of 12 to 36 inches, and finned lengths up to 10 feet. Aluminum fins on seamless copper tubing are standard, though copper fins may be ordered. Casings come in heavy gauge galvanized steel or aluminum, with connections for left or right hand.

When perfect performance depends on correct design, specify H&M coils. Ask your wholesaler for complete information or write to Halstead & Mitchell, Bessemer Bldg., Pittsburgh 22, Pa.



H&M's EXCLUSIVE TURBU-FLO FIN

HM Halstead & Mitchell

Finned Coil Products • Air-Cooled Condensers • Water-Cooled Condensers • Cooling Towers

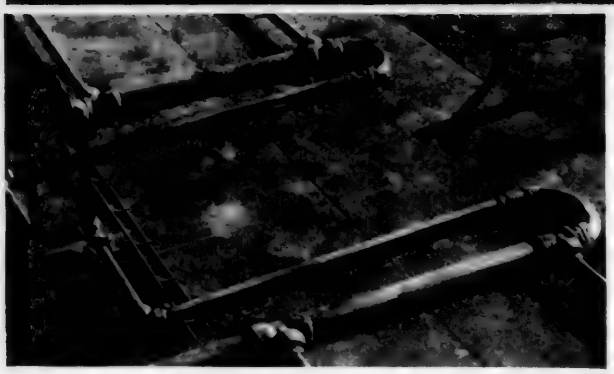
27,000 feet of heat . . .

Here, at the U. S. Air Force Academy, near Colorado Springs, Colorado, the most modern equipment in the world has been used to provide for the comfort and safety of America's future sky-generals. For instance, a huge radiant heating installation, featuring almost 27,000 feet of ¼-inch USS National Steel Pipe, serves the Cadet Quarters Complex.

For installations such as the Air Force Academy, architects and contractors consistently look to USS National Pipe. As a matter of fact, they've been specifying National for more than 60 years for conventional plumbing and heating systems. It makes sense, too! You know why? Because National Pipe has the qualities to meet the requirements of these applications . . . smooth, uniform bending . . . sound, strong welding . . . and long service life. These qualities have made USS National Pipe the largest selling pipe in the world. For more information, write to National Tube Division, United States Steel, 525 William Penn Place, Pittsburgh 30, Pa.

USS and National are registered trademarks

The world's largest and most experienced manufacturer of tubular products



National Tube Division of United States Steel

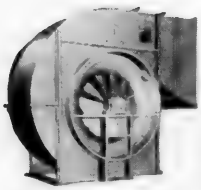
Columbia-Geneva Steel Division, San Francisco, Pacific Coast Distributors
United States Steel Export Company, New York

So Quiet-

YOU COULD HEAR HIS TEMPERATURE DROP!

Stretching a point? To be sure, but only because falling temperatures don't make much noise. Fact of the matter is, with "Buffalo" fans serving our imaginary hospital, you could hear just about anything, or nothing, the fan noise level is so low.

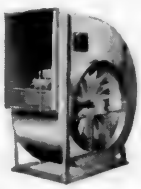
This is only one of the reasons you should insist on "Buffalo" Fans for your ventilating - air conditioning systems. If you would like to know more, read on.



THE "BUFFALO" TYPE "BLH" FAN FOR HIGH PRESSURE

For your high pressure systems (Class III and IV) "Buffalo" offers their Type "BLH" Fan. This fan also has an exceptionally low noise level while offering high mechanical efficiencies over a broad operating range.

Famous "Buffalo" "Q" Factor quality construction is used throughout providing a long life of low-maintenance, trouble-free service. For your conduit air conditioning and other high pressure jobs, the specially designed "Buffalo" Type "BLH" has more to offer than any other suitable fan.



THE "BUFFALO" TYPE "BL" FAN FOR MODERATE PRESSURE

Here's a highly refined fan design suitable for your general air moving jobs. Low noise level is but one of the advantages of this design. Another is high efficiency, particularly important as horsepower requirements rise. A third consideration might be the minimum amount of maintenance necessary with the "Buffalo" type "BL" fan.

This tells but a fraction of the story. If you want to be really sure of the fans on your next moderate pressure job, see that they are "Buffalo" Type "BL's".

Additional information on these and other "Buffalo" Fans can be obtained from your nearest "Buffalo" Engineering Representative. Or write us direct if you wish. Your letter will receive our prompt attention.

BUFFALO FORGE COMPANY
Buffalo, N. Y.
Buffalo Pumps Division, Buffalo. N. Y.
Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

"Buffalo"

VENTILATING • AIR CLEANING • AIR TEMPERING • INDUCED DRAFT • EXHAUSTING • FORCED DRAFT • COOLING • HEATING • PRESSURE BLOWING

As functional as it is attractive . . .

New H. J. Heinz research center is another endorsement for Transite® Vent Pipe!

Architects and Engineers:
Skidmore, Owings & Merrill
Partner in Charge: Gordon Bunshaft
Consultants on Mechanical Engineering: Jaros, Baum & Bolles
General Contractors:
George A. Fuller Company

Visit the H. J. Heinz Company's new Research Center and you see a strikingly attractive structure . . . *and every bit as functional!* Here—every design detail, every material used contributes to greater scientific productivity.

Within the many laboratories—equipped to test foods for taste, aroma, color, appearance—there's a marked accent on cleanliness. Every piece of equipment is planned to prevent contamination, to stay clean and rust free. That's why corrosion-resistant Transite Industrial Vent Pipe was chosen to vent every one of the Research Center's laboratories.

Whether used indoors or out, Transite offers you many advantages. Made of asbestos-cement, Transite retains its original, attractive appearance. *Saves on upkeep* because it never needs painting or preservative coating. *Saves on maintenance* because it resists the attack of most gases, mists, fumes and dusts . . . is unaffected by weather.

For further information on Transite Industrial Vent Pipe, write to Johns-Manville, Box 14HV, New York 16, N. Y. In Canada, Port Credit, Ontario.

Photo by Ezra Stoller

JOHNS-MANVILLE

JOHNS-MANVILLE JM PRODUCTS

direct
drive
...makes fume removal an inside job
Installed directly in ductwork, space-saving DeBothezat Bifurcator Fans provide efficient direct drive power for fume removal.
Damaging fumes are kept away from the motor by a housing of acid-resistant metal alloy or of steel protectively coated with PVC (plasticized polyvinyl chloride) and many other types of synthetic linings. Fan wheels in a complete size range can also be made with similar anti-corrosion protection.
Save Installation Dollars
Installing a DeBothezat Bifurcator Fan is about as quick and simple as putting in a section of ductwork. Direct drive eliminates recurring maintenance problems. From space-saving installation to long-term operating economy, DeBothezat Bifurcator Fans keep costs down all the way. Contact a DeBothezat representative for further details or see our section in Sweet's Plant Engineering File.
De Bothezat™ FANS
A DIVISION OF
American Machine and Metals, Inc.
EAST MOLINE, ILLINOIS
FOR FURTHER INFORMATION
SWEET'S
PLANT ENGINEERING FILE
OR WRITE FOR COPY
IN CANADA: Represented by DOUGLAS ENGINEERING CO. Ltd., Toronto—Montreal

46 Industry Leaders Support the ARI Seal

The 46 manufacturers listed here are helping to make the ARI program grow daily in value and importance, through the use of the ARI Seal of Certification on the equipment they produce. They're leaders of the industry, accounting for about 90% of total U. S. unitary equipment.*

These are the important names backing the ARI program. And here's what the program does:

1—It takes the guesswork out of a complete system. You can now specify with assurance, because you'll be working with units of assured cooling capacity.

2—It makes your selling job easier. By providing a standard capacity-rating, the ARI program helps dispel confusion for prospective customers.

3—It helps cut down expensive service calls, because ARI-certified equipment means guaranteed performance, backed by the manufacturer, as proven and established under test by the industry.

**"Unitary" air-conditioners: all packaged air-conditioners, whether single units or combined units (called "split" systems) up to 135,000 btu in capacity, but not including room air-conditioners or heat pumps.*

For free explanatory booklet and Directory of participating manufacturers, write to: Chief Engineer, Dept. B-6, Air-Conditioning and Refrigeration Institute, 1346 Connecticut Avenue, N. W., Washington 6, D. C.

Airtemp Division, Chrysler Corporation
Amana Refrigeration, Inc.
American Furnace Company
American-Standard Industrial Division, American Radiator and Standard Sanitary Corporation (formerly American Blower Division)
Arkla Air Conditioning Corporation
Armstrong Furnace Company, Division of National Union Electric Corporation
Bryant Manufacturing Company, Division of Carrier Corporation
Carrier Corporation
Cobell Industries Inc.
Columbia Specialty Company, Inc.
Continental Manufacturing Company
Coolerator Division, McGraw-Edison Company
Curtis Manufacturing Company
Day and Night Manufacturing Company, Division of Carrier Corporation
Florida Warren Corporation
Fraser and Johnston Company
Friedrich Refrigerators, Inc.
Frigidaire Division, General Motors Corporation
Gaffers & Sattler, Division of Utility Appliance Corporation
General Electric Company
Gibson Refrigerator Company, Division of Hupp Corporation
Grove Furnace, Inc.
Hall-Neal Furnace Company
International Heater Company
Janitrol Heating & Air Conditioning Division, Surface Combustion Corp.
Lennox Industries Inc.
The Majestic Company, Inc.
The Mathes Company, Division of the Glen Alden Corporation
Miami Products, Inc.
Mueller Climatrol, Division of Worthington Corporation
National Thermatic Corporation
National—U. S. Radiator Corporation
The Payne Company, Division of Carrier Corporation
Peerless Corporation
Perfection Industries, Division of Hupp Corporation
Rheem Manufacturing Company
Round Oak Company of Indiana, Inc.
A. O. Smith Corporation
Southwest Manufacturing Company
Therm-Air Manufacturing Company
The Trane Company
Typhoon Air Conditioning Company, Division of Hupp Corporation
United States Air Conditioning Corp.
Westinghouse Electric Corporation
Worthington Corporation
York Corporation, Subsidiary of Borg-Warner Corporation

WIDE OPEN for Fast Wiring and Inspection

NEW complete line of low voltage motor control

Wide-open accessibility and modern design assure fast and easy installation, modification, inspection and maintenance of this new line of Size 0 through 4 Allis-Chalmers control. For instance, large and clearly marked terminals, pressure connections for all wiring, wide and deep-cut screw slots, clearly visible contacts, easy coil replacement, readable rating plates, "out-front" overload relays.

Flexibility

This new line of control permits making many modifications in the field with ease. Minimum parts requirements facilitate delivery from local stock.

Unsurpassed Mechanical and Electrical Life

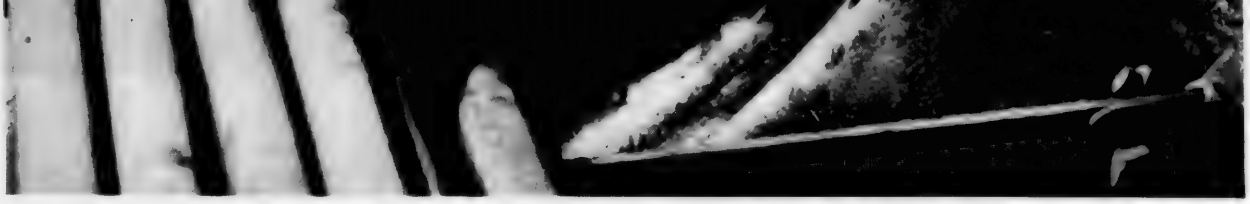
Millions of "life-test" operations attest to the functional quality in every detail — assure the ultimate in dependable performance and sure protection for personnel, motors and machines.

A complete line of low voltage control (Size 0 through 8) and high voltage control *in all NEMA* enclosures, plus engineered control systems. Your A-C distributor or representative will give you all the details. *Or write Allis-Chalmers, General Products Division, Milwaukee 1, Wis.*

Plan to stay ahead... MODERNIZE!

ALLIS-CHALMERS

A-5984



Still no sign of wear or corrosion in Patterson-Kelley storage water heater

AFTER 26 YEARS OPERATION

Credit Revere Copper for this outstanding performance

The copper-lined heater you see above was installed in the Bronx County Courthouse Building, New York City, in 1932, and processes rust-free hot water for the 1,000 staff members and more than 5,000 visitors daily.

Department engineers inspected the heater annually, the last inspection being in June, 1958. At that time the above photo was taken of the heater's interior. After 26 years constant use, processing over 8,500,000 gals. of water at the average rate of 4 tons per day, the heater was found to be in excellent condition, all original fittings in good operating condition and copper tube bundles and supports showed not one sign of wear or corrosion. Once again copper has proved a most efficient, economical and durable material in storage water heater service.

Find out how copper and its alloys can help you in your corrosion problems, whether it be storage water heaters, heat exchangers, condensers or distillation units. Call on Revere's Technical Advisory Service with its great storehouse of knowledge on this subject.

REVERE COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801
Executive Offices:
230 Park Avenue, New York 17, N. Y.

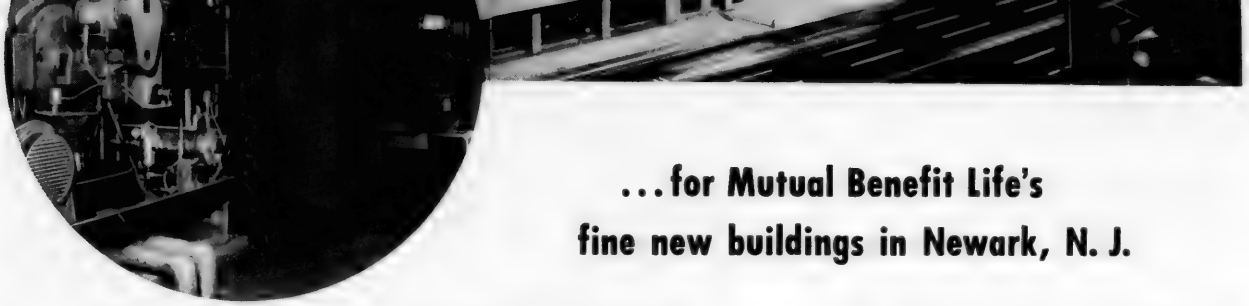
Mills: Rome, N. Y.; Baltimore, Md., Chicago, Clinton and Joliet, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Brooklyn, N. Y.; Newport, Ark.; Ft. Calhoun, Neb. Sales Offices in Principal Cities. Distributors Everywhere.

Here Timing Counts...

The pitch is on the way. from here on in, the batter's timing really counts! And when it's *your* turn at bat to solve a motor-drive problem for appliances or equipment, Emerson-Electric will work with you to make your timing *perfect!*

Remember . . .

- Emerson-Electric produces *custom-engineered* motors to suit *your specific needs.*
- We specialize in solving motor-drive problems *like yours*, and we have a back-log of more than 65 years of experience.



...for Mutual Benefit Life's fine new buildings in Newark, N. J.

Complete firing system in one package. Every factor that affects firing efficiency is engineered into the unit at the factory. The unit includes: (1) Single or dual-fuel burner, with complete fuel handling systems. (2) Forced draft air supply. (3) Enclosed control panel, with instruments mounted, factory wired and tested, and with signal lights and gauges that afford a complete reading at a glance. In the oil-gas units, fuels can be switched automatically, or with the simple flick of a switch.

Fire low cost residual oils

The heavy residual fuel oils (No. 5 and 6) have higher heat value than light heating oils, yet cost less per gallon.

The Iron Fireman boiler-burner units shown here fire these sluggish oils with complete dependability. They protect against fuel emergencies because they can fire *any* grade of oil, light or heavy.

Gas or oil—switch fuels instantly

Dual-fuel models fire either gas or oil, and can be switched either by manual or automatic controls. In some areas gas rates are substantially less for customers whose steam plants switch automatically from gas to oil firing when outdoor temperature falls below a certain level, relieving the load on main gas lines when demand is highest.

Fires all types of boilers

Iron Fireman residual oil firing (with or without gas) is available in complete boiler-burner units ready for service connections, or as a package firing system that can be applied to any type of boiler.

Send coupon for further information

IRON FIREMAN®

AUTOMATIC FIRING EQUIPMENT

FOR OIL · GAS · COAL

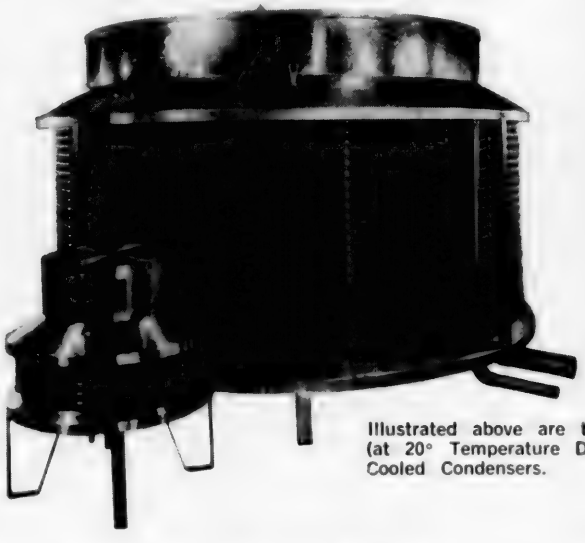
IRON FIREMAN MANUFACTURING COMPANY
3155 West 106th Street, Cleveland 11, Ohio
(In Canada, 80 Ward Street, Toronto, Ontario)

Please send information on Iron Fireman forced draft firing for oil, gas or oil-gas combination.

Name .....

Address .....

City ..... State .....

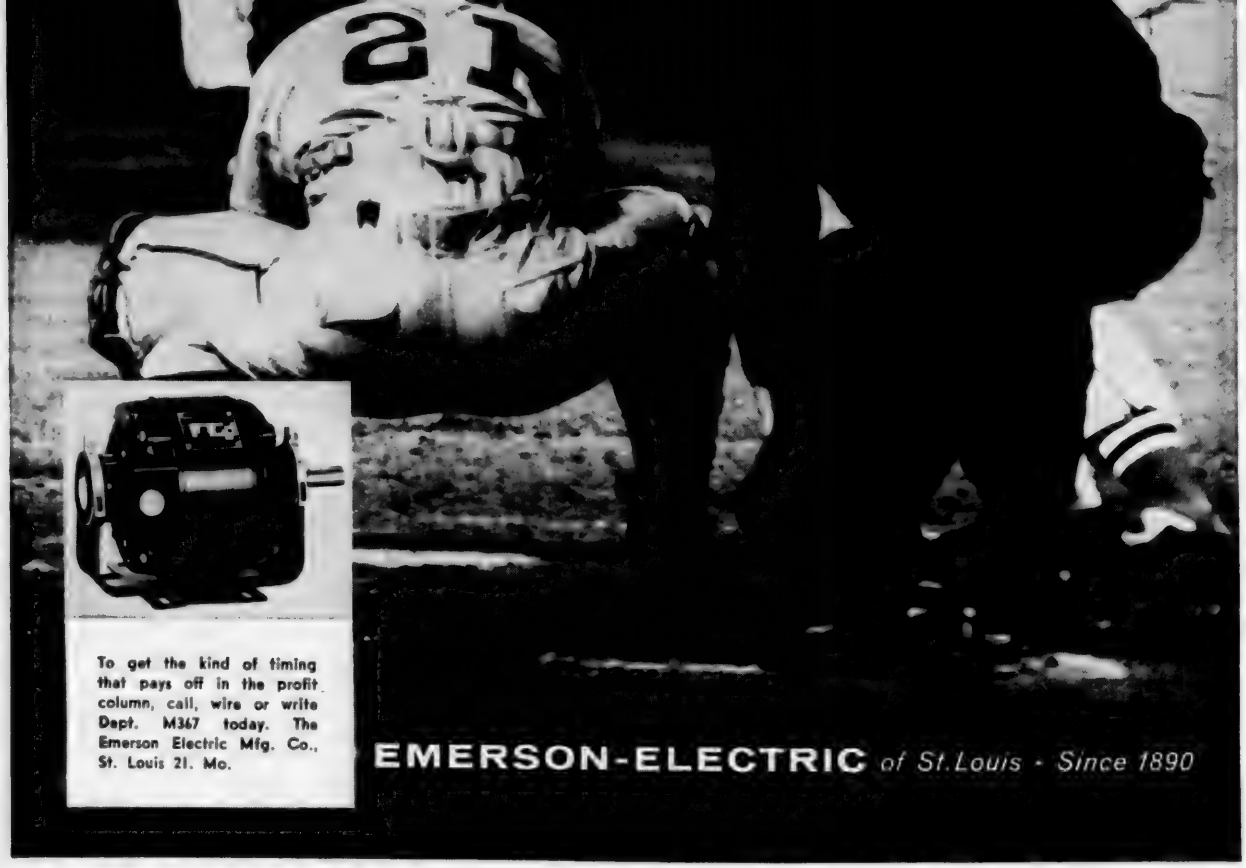


FANDAIRE
the engineered
CIRCLE
of efficiency

Illustrated above are the 3 ton and 80 ton (at 20° Temperature Difference) Fandaire Air Cooled Condensers.

Here's WHY Fandaire Air Cooled Condensers Are Better!

1. **GREATER CAPACITY** . . . Fandaire air cooled condensers are available in 2 through 80 ton units. Fandaire air cooled condensing units are available in 2 through 10 ton units. All are designed to fit any commercial, residential or industrial application.
2. **MORE ECONOMICAL** . . . all Fandaire units are comparative in actual dollar cost to competitive units. But when you read all the extra benefits listed below — available only on Fandaire Air
7. **POSITIVE CONDENSATE DRAINAGE** . . . each row or circuit of tubes slopes downward at a 30° angle. The outlet tubes are lower than the inlet tubes assuring a better drainage of all condensate as fast as it forms. No pockets of compressor oil can form to act as an insulator between the hot gas and the air cooled tube walls.
8. **STRAIGHT THROUGH FLOW** . . . each circuit consists of one continuous length of a single tube. This completely eliminates all pressure drop caused by the return bends on rectangular units.


To get the kind of timing that pays off in the profit column, call, wire or write Dept. M367 today. The Emerson Electric Mfg. Co., St. Louis 21, Mo.
EMERSON-ELECTRIC of St. Louis · Since 1890

how the *Peer* is put in

Peerless Electric®

• As a final inspection—all Peerless Electric Fan and Blower products—large or small—are electronically tested and checked for balance under actual operating speeds. Corrections are made on the spot, when necessary. When shipped, the unit is in perfect dynamic balance. This is another Peerless Electric manufacturing function that produces a superior-quality product.

WRITE TODAY FOR CATALOGS!

FAN AND BLOWER DIVISION

THE *Peerless Electric*® COMPANY

Also Manufacturing The Massachusetts Line®

WARREN, OHIO

Member of the Air Moving and Conditioning Association, Inc. (AMCA)

Cooled units — you'll have to agree that these units are by far the most economical.

3. **GREATER FIN SURFACE EFFICIENCY** . . . Fins are helically formed around a heavy-wall copper tube. They are spaced 8 fins per inch to permit free passage of lint and dust carrying air. The shoulder of each fin is firmly swaged to the tube AND to the adjoining fin. No foreign matter or corrosion can form between the tube and shoulder to cause loss of heat transfer, even after years of exposure. This shoulder provides maximum contact with the tube and guarantees that the greatest amount of heat will be transferred to the fin.
4. **UNIQUE FIN DESIGN** . . . permits greater heat transfer than plate type fins. Fandaire fins are 20 thousands at the base tapering to 8 thousands at the tip. As heat is dissipated along the fin, less thickness is necessary to maintain the highest heat temperature and transfer. Where even thickness plate type fins will lose temperature towards their tips, thus losing their heat transfer efficiency, the pyramidal Fandaire fin will not.
5. **LESS POWER REQUIRED** . . . This unique fintube offers a lower ratio of fin surface to prime surface (13 to 1). At the same time they have a much greater amount of prime surface than most competitive condensers. This permits a better rate of heat transfer and lower static pressure permitting MORE air to move across the coils with LESS power consumption in the fan motor.
6. **TRUE COUNTER FLOW** . . . an action in which the hot refrigerant is gradually cooled by flowing against (or counter to) the source of the cooling medium. In other words the refrigerant flows hot to cool, or counter to the cooling medium (air) which flows cool to hot. The hot gas enters the condenser tubes at the inlet header inside the condenser and makes 5 complete circles before leaving the tubes at the outlet header. Since the cool air enters the condenser around the periphery of the coil and is pulled through the bank of tubes, the coolest air is always in closest contact with the tubes carrying the coolest gas. This provides the best possible counter flow and assures a greater mean temperature difference at all times giving a higher rate of heat transfer, lower condensing temperature and a greater degree of sub-cooling.

This long sweep, one circuit construction approaches the almost non-existent pressure drop of a single pass unit while having all the advantages of a five pass unit.

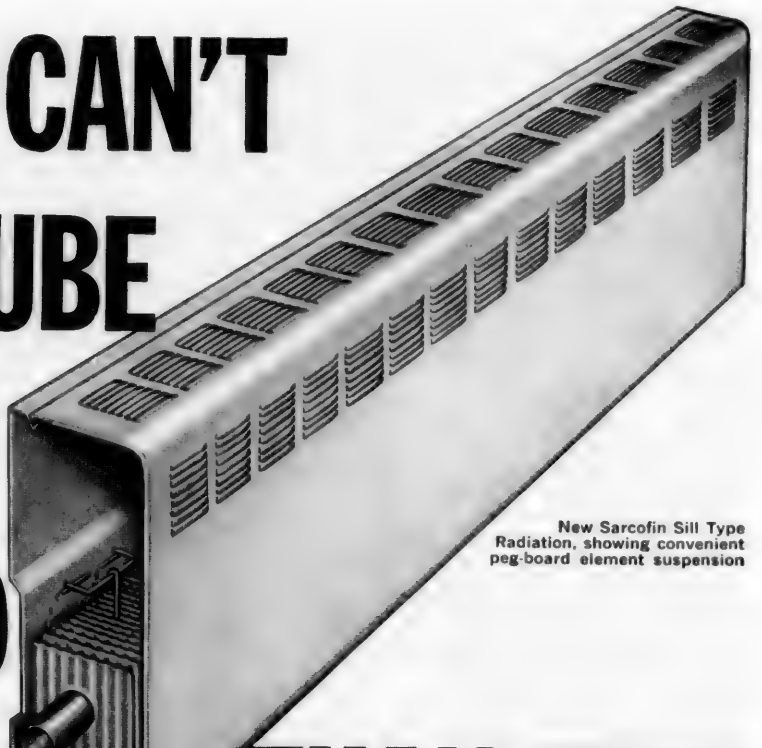
9. **RETURN BEND LEAKAGE ELIMINATED** . . . approximately 70% less solder joints on the Fandaire straight through flow design than are required by rectangular units and their return bends, means leakage due to bad joints is almost completely eliminated.
10. **VERTICAL AIR DISCHARGE** . . . is standard construction. No air scoop or deflector is necessary. This vertical air discharge eliminates any tendency to recirculate hot air and is a must on multiple installations. In addition, the 8" fan stack on all units also insures against any recirculation of hot air thus increasing the efficiency of the fan. Wind from any direction can be used and no dead spots can be found on the face of the coil since the air is drawn around the circumference of the coil. It also eliminates any tendency to kill shrubbery and grass and to peel paint.
11. **HOUSING** . . . all models are weatherproof and come in attractive, corrosion resistant housings of spun construction. The extremely low silhouette eliminates any "eye sore" look. Models up to 7½ tons are made of aluminum alloy. All other models are galvanized after construction for durable, maintenance free finish. The air conditioner units are supplied with a two piece, wrap-around skirt.
12. **MOTORS** . . . either direct drive or belt drive, weather proof or totally enclosed, ball bearing, permanently lubricated motors are used on all Fandaire units.
13. **FANS** . . . are axial flow type and are constructed from plated, heavy duty corrosion resistant steel, aluminum or cast aluminum.
14. **GUARANTEE** . . . all units are fully guaranteed for one year against defects in workmanship and material.
15. **LEGS** . . . are standard equipment. They are designed to easily fit on existing bases when being used as replacement for water towers. They are sturdy and provide ample support. No guy wires or other supports are needed to keep unit from tipping over.
16. **FAN GUARDS** . . . are also standard equipment. They are made of heavy gauge wire spaced at ½ inch to prevent birds, leaves and other matter from interfering with operation.

For further information concerning these revolutionary units contact:

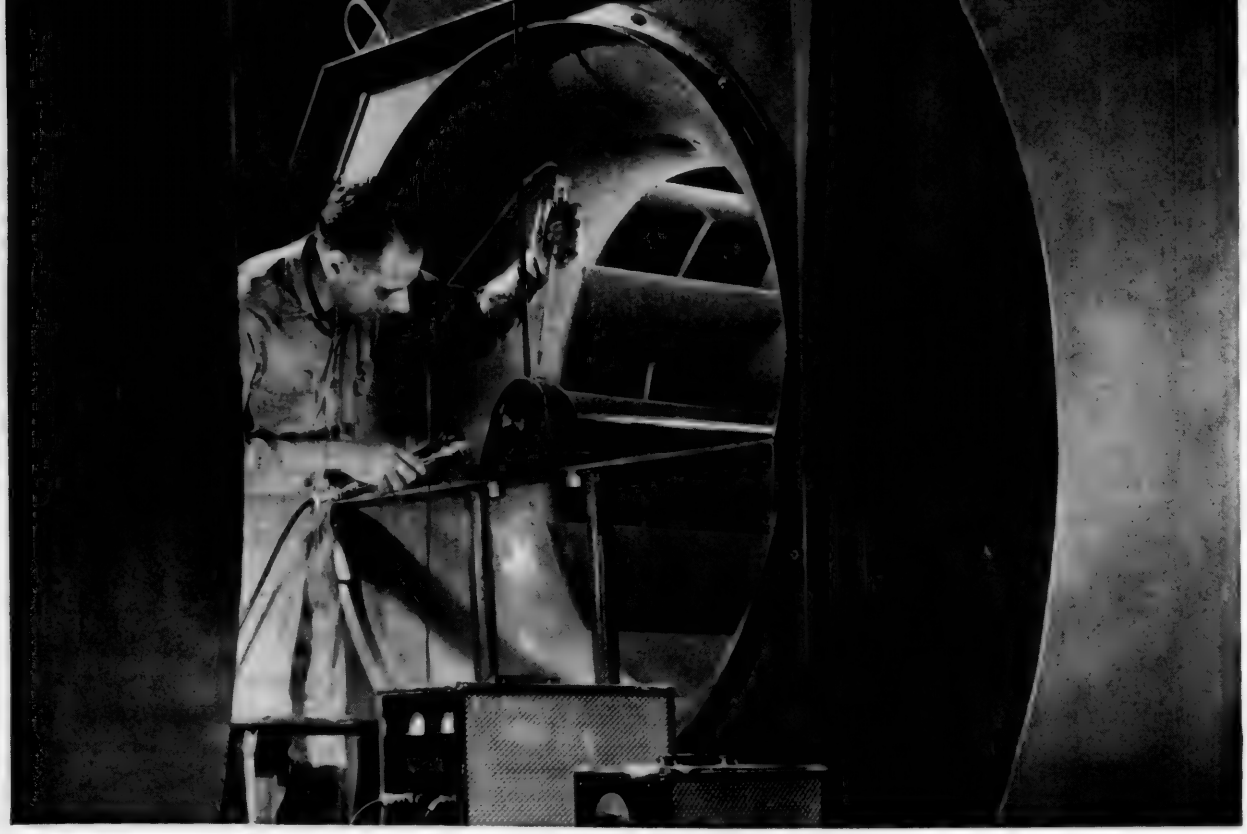
f5 air conditioning corp.
1815 SOUTH MAYBELLE · TULSA, OKLAHOMA

REPRESENTATIVES IN PRINCIPAL CITIES

YOU JUST CAN'T FIND FINTUBE THAT'S EASIER TO



New Sarcofin Sill Type Radiation, showing convenient peg-board element suspension



NEW SARCOFIN SILL TYPE RADIATION

This new Sarcofin Custom Built Sill Type Radiation puts three important assets in your hands: high heating efficiency, great flexibility of application, and extreme ease of installation. The 16-gage steel cabinet is reinforced with strong, vertical supports welded at close intervals to the inside of enclosure to lend strength and rigidity to the entire assembly.

Rounded contours and precision flanges give smooth assembly, completely free of splicing plates and unsightly bolts. Peg-board element suspension means easy, fast mounting with end-to-end rigidity. Ample allowance for expansion and contraction.

Write for helpful Bulletins giving radiation data, pressure and temperature correction factors, and unit dimensions. Ask for:

No. 1660—Sarcofin Sill Type Radiation

No. 1650—Finned-Tube Commercial Radiation

No. 1640—Finned-Tube Baseboard Radiation

SARCO COMPANY, INC. • SARCOTHERM CONTROLS, INC.

635 Madison Avenue, New York 22, N. Y.

6151-B

Climate by Chrysler

... your clients would pay $364 just to get the standard "extras" alone

If your clients went out to buy all the valuable extra features that are standard only on Chrysler packaged air conditioners, they'd pay up to $364! Here's what they'd get:

1. **Light load capacity control.** Brings down humidity rapidly and economically when outside temperatures are moderate.
2. **Electro-magnetic safety controls.** Increase the service life of your air conditioning equipment.
3. **Mild-weather control.** Keeps equipment running on mild days when others fail.
4. **Quick-response expansion valve.** Brings you steady supply of cool air in 30 seconds. Cuts operating costs and wear on parts.
5. **Oil rectifier.** Cleans and purifies the system's

Slammin' Sam Snead fails to flake Inland TI-CO®

One of golf's greatest players, Slammin' Sam earned his name and fame with a driving power that has seldom been equalled. His swing is deceptively easy—yet it drives the ball with astounding force and speed. At Boca Raton, Sam drove ball after ball into an Inland TI-CO galvanized sheet. Each impact was terrific. Yet, though the TI-CO sheet was battered and dented, *there was no trace of flaking of the zinc coating whatsoever!*

Any Sheet Metal Man who has used TI-CO on a job could have told Sam . . . "You just *can't* flake TI-CO!" You can Pittsburgh lock-seam it, crimp it, hammer it, give it the most complicated forming in the book—and TI-CO won't crack, peel or flake. That's why so many Sheet Metal Men specify INLAND TI-CO galvanized sheet—*every time!*

Ask your Steel Service Center for the TI-CO Brand . . . the galvanized sheet that's tailor-made for sheet metal work.

Sam couldn't believe it either 'til he examined the TI-CO sheet for himself. *Not a trace of flaking!*

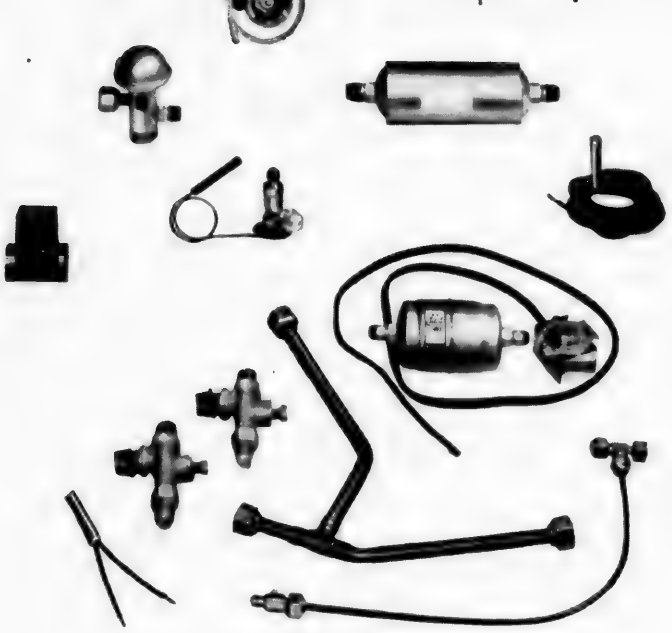
INLAND TI-CO

AMERICAN STEEL WAREHOUSE ASS'N

INLAND STEEL COMPANY

30 West Monroe Street • Chicago 3, Illinois

THIS NEW VACUUM HEATING PUMP IS SIZED TO ACTUAL JOB REQUIREMENTS



3. Oil Reclaimer. Cleans and purifies the system's lubricant; protects your equipment better, prevents service break-downs.

When you select Climate by Chrysler, your clients get much more than just coolness for their air conditioning investment. Exclusive features, low operating costs, reduced maintenance are three of the many advantages they get from Chrysler—the company that pioneered packaged air conditioning. For complete specifications and technical information, write: Airtemp Division, Chrysler Corporation, Dept. I-69, Dayton 1, Ohio. Canadian Distributor: Therm-O-Rite Products, Ltd., Toronto, Ontario.

CHRYSLER AIRTEMP

FIRST WITH THE FINEST IN AIR CONDITIONING

Air Conditioning Raises Output, Yields Other Advantages to Office Workers, Government Reports

Air conditioning increases work output nearly 10%, improves employee morale, decreases absenteeism, cuts chilled drinking water consumption, and has other advantages to employers and employees, according to carefully conducted tests by General Services Administration which operates, for the Federal government, buildings totaling 74,000,000 square feet.

RESULTS of a 5-month study on the effect of air conditioning on work output of employees have been made public by the Office of Buildings Management, General Services Administration of the U. S. Government. Work production in air conditioned spaces was found to be from 6.5% to 13.5% higher than that in the non-air conditioned spaces. Further, absenteeism was 2.5% higher for employees in the non-air conditioned space than in the air conditioned areas.

Among the intangible benefits of air conditioning GSA found that there was less consumption of chilled drinking water, girls were pleased with the savings in money

mined number of these searches.

The department not only gave consent to the test, but cooperated to the fullest by collecting the extensive data required.

Selection of Test and Control Areas

The building in which the test was conducted is a wing-type structure, with the head house in the center. The wings were of open construction, without definite corridors. The west wing was selected as the test area, and the center wing as the control area. Both were princi-

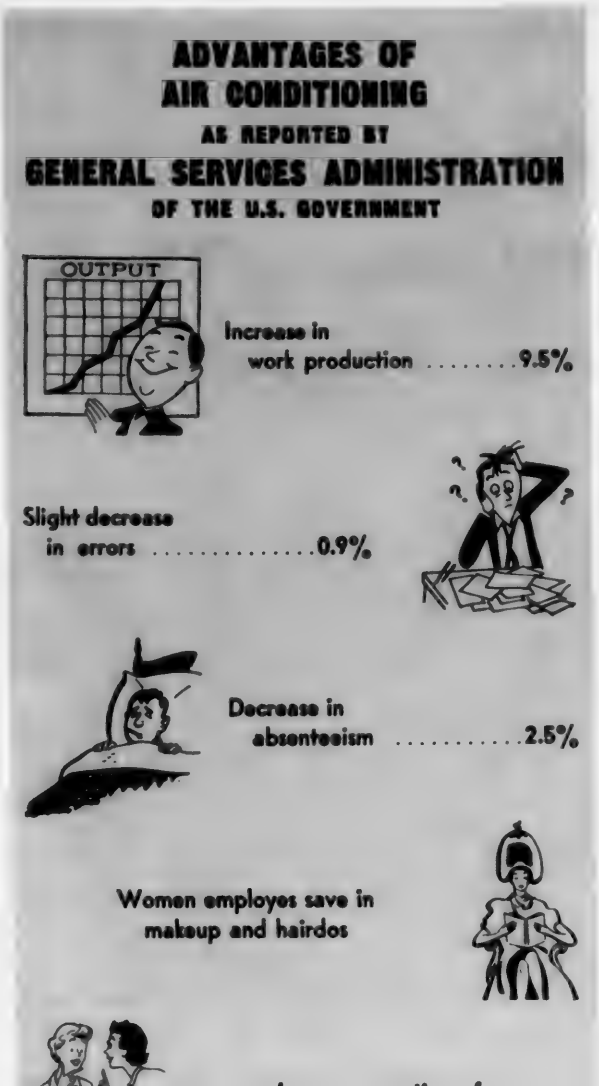
It's the Nash CSM

No longer is it necessary for the Engineer to accept a vacuum heating pump with air and water capacities based inflexibly upon square feet of equivalent direct radiation. With the flexible Nash CSM he can provide for proper air capacity in accordance with his judgment and experience. For the individual capacities of the separate pumps on the CSM may be varied within a wide range, without buying an oversize receiver and oversize water pumps.

These pumps possess many other features which permit a more efficient utilization of fuel and minimum use of electric power. Low, low, returns reduce installation costs and usually eliminate putting the pump in a pit. Simplicity and efficient operation reduce supervision and maintenance costs. Information regarding this new heating pump development is available immediately upon request.

- Increased air capacity induces rapid system response without wasteful overheating.
- Separate air and water pumps individually selected to meet actual job requirements.
- Control system that operates individual pumps only when needed.
- Flexibility permitting addition of radiation without changing basic pump installation.
- Low, low, return line connection.

NASH ENGINEERING COMPANY
438 WILSON, SO. NORWALK, CONN.



doned. Under the revised plan, existing lighting and painting conditions in both areas were changed. Identical painting and lighting were provided so that, with the exception of air conditioning in the test area, all employees would be working under the same conditions.

The walls were painted a flat light green, and the ceilings flat white. The lighting fixtures were changed from semi-indirect incandescent to semi-indirect fluorescent.

Air Conditioning

The air conditioning system installed for the test area was operated to hold a uniform temperature of 75 deg F ($\pm$ 2 deg), and a relative humidity of not in excess of 50%. The cooled and dehumidified primary (outside) air was supplied by an overhead supply duct, running approximately the full length of the wing, with a sidewall outlet per bay discharging toward the windows.

The sensible cooling or heating was accomplished by fan coil units located under each window. These units were supplied with chilled or hot water, depending on the season. The east and west sides of the test area were controlled in groups by thermostats located near the center of the wing, while the radiators in the control area were hand controlled. The amount of outdoor air supplied to the test area was 3800 cfm (.23 cfm per square foot).

Selection of Work Groups

To assure a true comparison between the effects of air conditioning on the productivity of the two test groups, only employees who were thoroughly experienced were selected to work on these test teams.

Each of the participating teams consisted of 70 persons, or 140 in all. The average age of the employees working in the air conditioned area was 21.25 years, varying between 18 and 33, while the average age of those in the non air conditioned space was 21.51 years, ranging between 19 and 32. An equal number of men and women participated on each team.

The testing period covered five months (May through

ing water, girls were pleased with the savings in money on make-up and hairdos, attributed to the absence of fans and relief from the high Washington humidity, less soiling of clothing, and less feeling of tiredness at the end of the day.

The results of the study were reported by F. R. Brant, Director of the Research Division and Fred S. Poorman, Acting Assistant Commissioner for Buildings Management. Virtually their complete report follows.

General Services Administration is the Government landlord (it is responsible for maintaining and operating some 74,000,000 square feet of Government-owned space housing Government activities), and consequently wanted to know the measurable benefits of air conditioning on work production, accuracy and absenteeism.

Despite the great number of buildings under its supervision and the wide variety of work performed in them, GSA was, until recently, unable to find an activity suitable for testing the effects of air conditioning—one in which the same work is performed year after year, and where employee work output can be evaluated with some degree of accuracy.

Late in 1955, however, the agency found an operation in one of the Government departments which filled these requirements. The work performed there has not varied through the years. It consists of making great numbers of so-called "searches" (more than 100,000 each month), and each employee must complete a predeterpally occupied by file cabinets where the searches are performed.

All space was heated by direct radiators under the windows. Ventilation depended on opening the windows, with the usual disadvantages.

The lighting intensity was 4.3 watts per square foot, furnished by 500-watt semi-indirect incandescent luminaires. The walls were painted Government buff.

Original Objectives

Originally it was planned to make a threefold study:

(1) It was intended to study for a two-year period the effect of air conditioning on production. Only insignificant environmental changes were to be made in the test and control areas during this phase of the study.

(2) On completion of this two-year study it was planned to install "high intensity" lighting of about 100 footcandles in the test area, and to evaluate the additional effect.

(3) Following the second phase of the study, it was intended to change the environmental colors in the test area and study this effect.

Final Test Plan

When bids on the original plan were received, they exceeded available funds by a wide margin. Therefore, parts two and three of the three-phase study were aban-

this varied production curve. Neither could the occupying agency pinpoint the reason for this variation.

It is known to the agency, however, that this difference is typical of employees working on this assignment, as it had been observed for many years that such employees' production varied from month to month by a few percent. The difference in time required to complete a search can vary a great deal, depending upon the case—one search may take hours, and another only a few minutes. Generally the total number of completed searches averages out the same from month to month.

In the light of these observations it would seem logical that the employee's outside activities, which are a recognized factor in work production, were probably largely responsible for the variation in production.

Despite the "unknowns" in this study, the 9.5% average production increase in the air conditioned test area over the rate of production in the non-air conditioned control area is very significant and exceeded the agency's expectations. GSA knew, from previous studies, that a seven-minute saving in time per employee per day will more than pay for the expense of an air conditioning system. In other words, if work production increases only 1.5% per year, the system will pay for itself through savings in salaries.

During the test period the best work production in the non-air conditioned area occurred in June and September; in the air conditioned area production was highest in June, July and September. The low point in the air conditioned space was in August, and probably was related to the outside weather, (which was hot and humid), to which the employees were subjected during off-duty hours. If it were possible to run a test under controlled laboratory conditions, the reason for these differences in productivity might be found.

Decrease in Errors

In some months more errors were made in the air conditioned area than in the non-air conditioned. There

in stores, on streets, and in public conveyances for the major portion of the day, and therefore were exposed to all kinds of diseases prevailing in the community.

Intangible Effects

All employees, with the exception of one girl, preferred to work in the air conditioned space and hoped they would not be transferred out of it.

The most important reasons for this preference, from their point of view, are as follows (no attempt has been made to list them in the order of their importance):

(1) Considerably less consumption of chilled drinking water. This is a factor which may be worthwhile for GSA to pursue further, since a number of the buildings under GSA control have a population of over 10,000, and some as high as 30,000. A small saving in drinking water per person might mean a considerable saving in installation and operating costs.

(2) The girls were pleased with the noticeable saving in money on make-up and hairdos, attributed to the absence of electric fans and relief from the high humidity which prevails in Washington. It not only saved them money, it boosted their morale to know they still looked their best at the end of a busy day. The money saved was a very important item to these employees.

(3) Elimination of wall fans was appreciated by employees for still another reason. No matter where fans formerly were placed, there was always disagreement among the employees about where they should be located, and there were complaints about the noise and blowing of papers on the cabinets.

(4) Less soiling of clothing. All employees, both male and female, agreed that their clothing remained cleaner and fresher, and showed less staining due to perspiration and discoloration due to dirt. Many felt they could wear their day clothing to a social function that same night.

Less consumption of chilled drinking water
No arguments about wall fan locations
Less soiling of clothing
Employes less affected by heat after business hours

The testing period covered five months (May through September, 1957). During this time, due to marriage, military leave, promotions, reassignments, etc., the average number of employees in the test area dropped from 70 to 62.6, and in the control area to 62.2.

Increased Work Production

Does air conditioning increase work production? The answer to this most important question definitely is "yes."

How much is the increase? On this point the study was not completely conclusive. Since performance of the particular task involved in this test serves as a stepping stone for the advancement of the employees, there is a considerably greater than average turnover of personnel. As noted earlier, the number of employees participating dropped from 140 to 124.8 in the five-month test period, due to reassignments, marriages, etc. At this rate, the test and control groups would soon have dwindled to the point where the study would have become meaningless.

The records for the five-month test period show that the work production of the group in the air conditioned space varied all the way from 6.5 to 13.5% higher than that of the employees in the control area. Weather Bureau data for the period furnished no definite clues to

Picture Story:

Electric Heating for an

Electric heat for schools, pioneered in Pennsylvania by Buchart Associates, Architects and Engineers of York, Pa., was put to the acid test as winter weather tried the claims for the Locust Grove Elementary School, in Windsor Township, the first in the Commonwealth to be heated wholly by electricity. The school is a six-room building which houses 180 students in grades one through six. It was occupied for the first school term this winter.

From the outside, the Locust Grove Elementary School looks like any one of the many modern school buildings being erected in York County. The difference is on the inside. Instead of the conventional boiler room with its boilers, controls, fuel storage, valves, pumps and piping, one finds a small, immaculate transformer room. Here, quietly operating electrical equipment supplies the necessary power to each classroom to provide heat for this building.

The transformers rest directly on the finished floor in a small closet-like room in the center of the building. The primary service to the building is 4600 volts, three-phase; and secondary voltage is 115/199 volts, three-phase, four-wire wye. A building-type, free-standing secondary switchboard of the circuit breaker type supplies current to the unit ventilators and the twenty feet of baseboard radiation required in each room. Each classroom has its own thermostat for heat control during the day. In the evenings and on weekends and holidays, the school's heating system is set back to 55 deg and runs on an automatic clock. For convenience, the school is divided into two zones—one, a section of five classrooms, and the other, the health and administrative offices.

Future plans call for the expansion of Locust Grove Elementary School to fourteen classrooms. With the existing electrical facilities, heating these additional class-

Harvey J. Becker, principal of the Locust Grove Elementary School, feels that under the proper circumstances electric heat is ideal for today's schools. "So far," Mr. Becker says, "the trouble-free operation of the electric heating system has given us maximum comfort and convenience in our school. As far as costs are concerned, we feel that ours will be comparable with those of other heat sources and below the engineers' predicted figures. We are very pleased with our modern heating system."

Official cost figures, both estimated and actual, show that, for the most part, the performance of the electrical heating system was better than predicted.

Month	Estimated Cost	Actual Cost
September 1958	—	$28
October 1958	$35	110
November 1958	202	177
December 1958	327	320
January 1959	390	391
February 1959	355	288
March 1959	231	288

Buchart engineers are working with engineers from the local utility company to refine control settings to further effect economy. For this reason, it is expected that next

conditioned area than in the non-air conditioned. There was an average 0.9% increase in errors per person per month in the control area—a figure which is for all practical purposes identical with the average in the test area and does not permit reaching any definite conclusions. In this particular operation, accuracy is more important than production. If an employee has an abnormal number of errors per year he is reassigned to less exacting duties, so it is safe to assume that all employees keep their errors to a minimum and that the percentage of errors, regardless of working conditions, is fairly constant.

Decrease in Absenteeism

Accurate records were kept of all sick leave taken and its causes. All absences positively not associated in any way with air conditioning or the lack of it (fractured bones, operations, abscesses, skin rashes, bronchitis, etc.) were disregarded for purposes of this survey. This left only minor ailments, such as headaches and upset stomache, to be considered. The agency suggests that no definite conclusions be drawn from this test, but points out that in the non-air conditioned area the absenteeism was 2.5% higher than in the air conditioned space. This is the more striking considering that the groups mixed with each other and strangers at lunch time, rest periods,

(5) The majority felt that the heat after working hours did not affect them as much as formerly, when they were subjected to it all day.

Conclusions

On the basis of the evidence, it would seem fair to conclude that air conditioning resulted in:

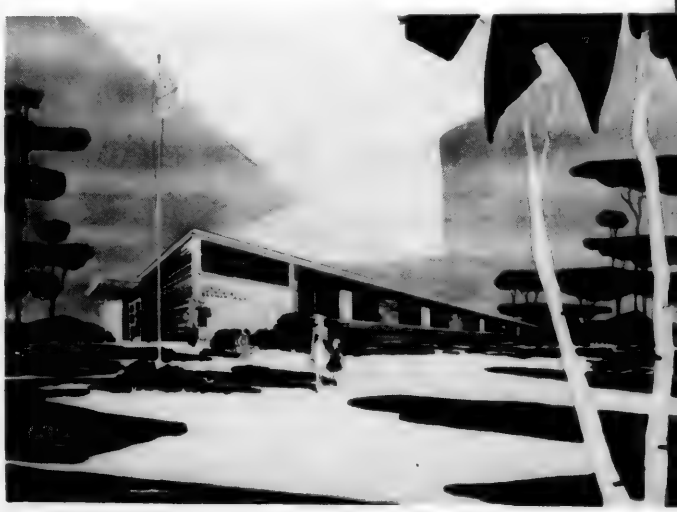
(1) A substantial average increase in work production (9.5%).
(2) A slight decrease in errors (0.9%).
(3) A measurable decrease in absenteeism (2.5%).
(4) A measurable decrease in employee's living expenses (savings on cleaning bills, hairdos, make-up, etc.).
(5) An important contribution to employee comfort and morale.

It is safe to assume that in any other type of office work, where the rate of production is not standardized, or where no minimum requirement must be met consistently, the increase in productivity would be more than enough to pay for air conditioning through savings in employee salaries.

The authors of the report feel certain that despite other changes in environment made at the time air conditioning was installed (such as a new paint job and new lighting), the air conditioning should be given most, if not all, the credit for the increased work production.

Elementary School

According to C. S. Buchart, senior partner of Buchart Associates, designers for this building, "The initial concept was developed from the need to furnish more perfect physical facilities for our growing educational system. A tremendous responsibility has been placed on architects and engineers to develop better and more economical facilities for the educational dollar being spent. Electric heat appears to be one of the answers to making a financial readjustment. According to our cost studies which, incidentally, were made for both electric heat and for conventional heat, the electric heat seemed to be the most economical in this instance. In this particular area the costs of installation and operation are competitive with other methods of heating. Savings effected are available to be used in the areas of teachers and supplies."



Locust Grove Elementary School
Windsor Township, Pa.

Consulting Engineers' Council Wages Fight for Improved Status for Engineers

REPRESENTATIVES of the Consulting Engineers Council's 24 member associations met last month in New York City. The occasion was the council's third annual board of directors meeting. During the four-day meeting no less than 60 subjects were covered which are of major importance to engineers engaged in private practice. Speaking at the annual installation-of-officers Banquet, newly-elected C.E.C. president, Ralph M. Westcott, Los Angeles, said regarding the council's many activities, "We are accepting our responsibilities and justifying our existence."

Ralph M. Westcott, newly-elected president, Consulting Engineers Council

Actions Taken

This prophetic statement was echoed in at least five actions taken by the C.E.C. Board during the course of the meeting. Briefly these actions follow:

1. All regular business was set aside as the Directors went into a huddle to answer a request from the National Council of State Boards of Engineering Examiners for a statement of policy with regard to corporate practice. The result was a resolution accepting incorporation of engineering firms where ownership and continuing control are in the hands of legally registered professional engineers.

2. Notification of a sleeper in H.R. 5915, the Department of Interior appropriations bill, calling for a 5% maximum on all engineering fees, resulted in the immediate dispatch of some 25 telegrams to various Congressmen urging that this provision of the Bill be dropped.

3. Applications for membership in Consulting Engineers Council received from consulting engineer organizations in Florida, Montana, Pittsburgh and Wisconsin were handled and approved on the spot. Representatives of each group were seated as full members of the Board.

4. Refusal of a leading manufacturer (Westinghouse) to discuss company employee engineers use of the title "Consulting Engineer," prompted the sending of a telegram to the president of Westinghouse requesting that a representative be named to attend the C.E.C. meeting and sit in on discussions of this subject. The vice president of the company's New York office met with the Council the day following and positive action on the matter is expected to be forthcoming.

5. The proposed placement of Illinois Engineering Registration Boards under that State's Department of Labor prompted the immediate preparation and adoption of a resolution requesting, among other things: (a) that independent public engineering be bodies under the jurisdiction of no special department of the State government; (b) that personnel of such bodies be nominated by professional engineering groups within the state; and (c) that all such personnel be restricted to registered professional engineers.

Complementing the above actions, the Consulting Engineers Council's Board of Directors also recorded much in the way of progress on regular matters.

Other Progressive Measures

Standard forms of agreement for use between Architect-Engineer and Engineer-Owner were introduced by the Documents Committee Chairman, George Poulsen, Jr., of Salt Lake City. These forms are now in the process of being printed and will soon be available for distribution from the council's Springfield, Illinois, office.

Newly elected vice president, Thomas R. Miles, of Beaverton, Ore., presented the first draft of a comprehensive C.E.C. Manual of Practice, which seeks to clarify in one volume: Various steps in performance of services, specific problems in ethics, recommended schedules for fees, standards for establishing office overhead, and relations with employees, clients and other consulting engineers. According to Mr. Miles, "Too many engineers are doing as little as permissible (in performance) for as much as possible (in dollars). The C.E.C. Manual of Practice is being prepared with the opposite philosophy, so as to provide a sound performance basis for evaluation of any negotiation situation." The first draft of the proposed manual covers 50 typewritten pages. It is expected that the final draft, approximately one year away, will be five times as long.

B. M. Dornblatt, New Orleans, outgoing treasurer, reported on the council's professional liability insurance program, describing it as being "well off the ground with about $200,000 now being paid in annual premiums."

While the entire C.E.C. program appeared to be undermined with the problem of dues (by limiting itself solely to owners, partners or principals of private engineering firms, the Council restricts its membership and accordingly must rely on individually higher dues) the Board of Directors nevertheless voted to proceed with a nationwide public relations program at a cost of ap-

(Concluded on page 158)

How Ventilation Costs Are Cut In Radioactive Areas

T. T. POREMBSKI

Facilities Engineer, Heating and Ventilating
Knolls Atomic Power Laboratory,* Schenectady, N. Y.

An account of the methods the author has employed in originating cost improvements applicable to the design of new, and the improvement of existing, ventilation systems at the Knolls Atomic Power Laboratory is given.

Some systems of equipment are described, with details of air flow, and the change of method which has effected operation economies. In most cases, these have been possible as a result of changes in laboratory needs. Possible cost savings were not always evident because original facilities were often more than adequate and passed unnoticed. In many such cases it was possible to modify the ventilation in some way which would reduce the cost of operation substantially. The cost of heating large quantities of make-up air at the Laboratory has been greatly reduced. On the other hand, in many instances outside air intake has been increased during winter months, eliminating mechanical refrigeration when cold outside air is available for cooling.

Ventilation equipment at the Knolls was designed and installed shortly after World War II when there was a critical need for the establishment of design criteria for the ventilation of laboratory facilities dealing with radioactive contaminants. This need has since been largely met, as a result of the combined efforts of designers familiar with laboratory operations.

DESIGN of a ventilation facility must provide for:

1. Contaminants and control of radioactive contaminants within the laboratory work area;
2. Removal of radioactive particulate material from the work area;
3. Satisfaction of ventilation needs of the occupancy.

In laboratory areas it is necessary to supply clean, conditioned, make-up air from the outside. This air passes through the laboratory once only and is then exhausted. Recirculation of air is not permissible unless the areas are completely clean and isolated. The direction of air flow within the building is always from non-radioactive to radioactive area, beginning outside the building and terminating at the work area. There the particulate materials are removed by the exhaust equipment, employing absolute filtration of the air before it leaves the building.

Air changes will vary from that number associated with ordinary ventilation or air conditioning and a number which may be as high as 60 air changes or more an hour. Air flow rate is governed by the minimum exhaust requirements as determined from the summation of the flows at each hood, etc.

Acceptable hood face capture velocities vary from 100 to 200 fpm. Velocities lower than 80 fpm are not tolerated under any circumstances. Duct velocities vary from 2,000 to 5,000 fpm depending on the material being suspended in, and carried by, the air.

Two systems are required, namely; supply and exhaust. Of the two, the exhaust is more important, and in fact, there is justification for dual exhaust fans and such other standby exhaust equipment as conditions warrant. Though the complete failure of air supply may be tolerated until necessary repairs are made, the supply system must be carefully designed to provide the most desirable air flow patterns possible within the room to avoid the spread of contaminants caused by stray currents of air.

Fourteen Ways to Economize

The author has repeatedly applied the following methods to reduce ventilating and conditioning costs:

1. Program system operations;
2. Establish proper air balance between air supply and exhaust systems;
3. Reduce outside air intake to a minimum;
4. Recirculate air whenever allowable;
5. Control outside air input for process area cooling;
6. Employ thermostatic control to operate exhaust fans primarily intended for summer use;
7. Improve automatic temperature control;
8. Relax ventilation design conditions;
9. Operate equipment at reduced capacity during nights and weekends;
10. Redesign ventilation equipment to match changes in area needs;

* Operated for the United States Atomic Energy Commission by the General Electric Company.

11. Deliver heat only where heat is required;

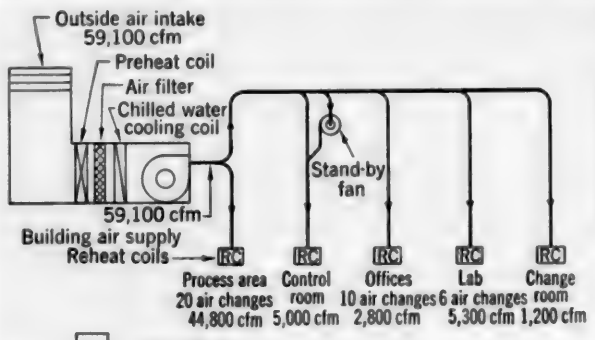
12. Add insulation to buildings when this is economically feasible;

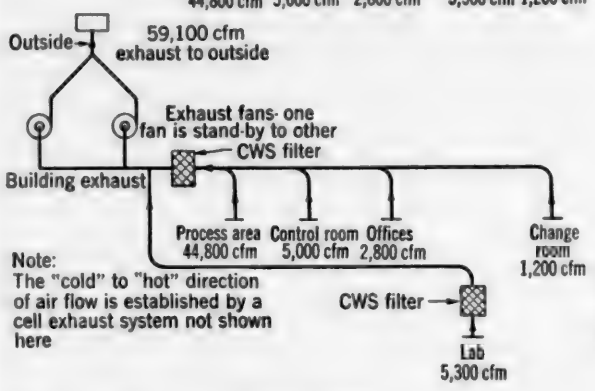
13. Eliminate heat stratification in areas having high ceilings; and

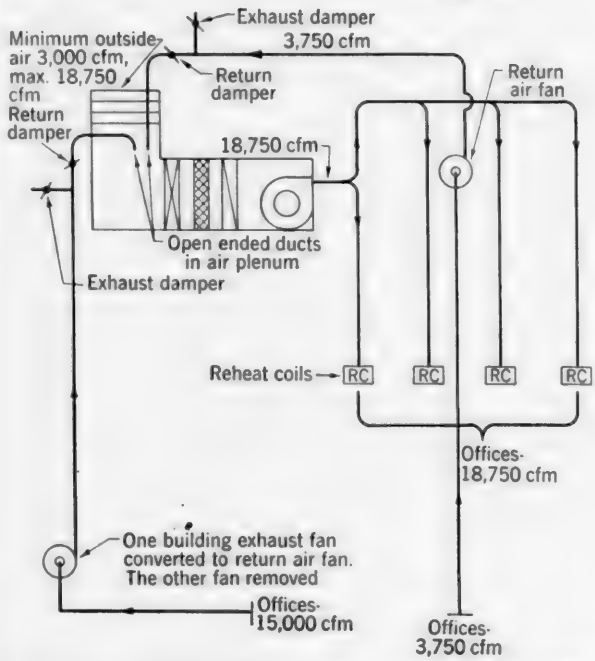
14. Decrease unnecessary infiltration at doors, etc.

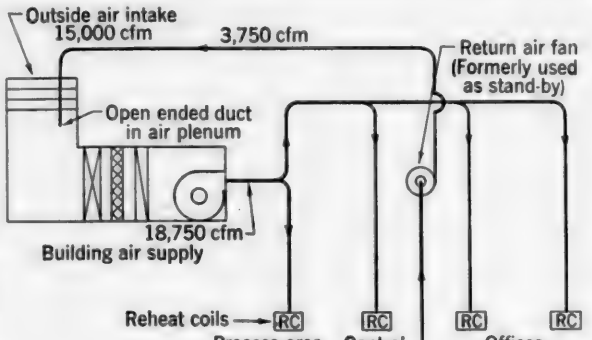
The first five items are of primary importance and are therefore described in detail. They drastically affect ventilation equipment design and economies thereof. The subsequent items are, for the most part, self-explanatory and are listed for reference purposes only.

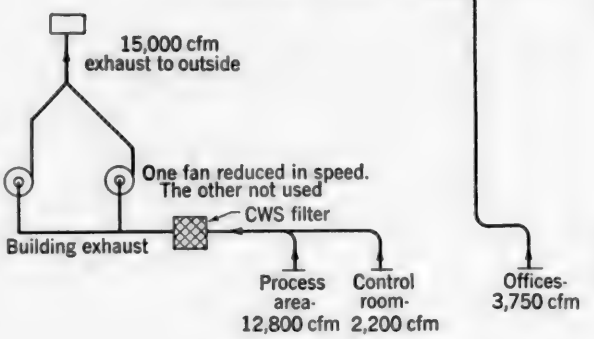
T. T. Porembski is a graduate chemical engineer of Northeastern University. He is a registered professional engineer of the Commonwealth of Massachusetts and has had eighteen years' experience with General Electric Company in engineering design and construction, having extensive experience in the design of heating, ventilating, air conditioning, refrigeration and process equipment for general plant projects. He was first employed at the River Works Plant in Lynn, Mass., and in 1956 joined the Knolls Atomic Power Laboratory as Facilities Engineer, Heating and Ventilating. The Knolls Laboratory, Schenectady, N. Y., is operated by General Electric Company for the U. S. Atomic Energy Commission.











REDESIGN OF SUPPLY-EXHAUST SYSTEM

How a supply-exhaust system can be redesigned to recirculate part of the air and thereby reduce heating costs is shown in these three schematics. Figure 1. (top, left) is an example of a system employed in a controlled area which will be converted to a system employing partial recirculation. Figure 2. (top, right) shows the manner in which the author has redesigned the system to recirculate part of the air. Figure 3. (bottom) is a second step in redesign, showing a complete conversion of the system as it will be when and if the area is decontrolled and completely reconverted to office use.

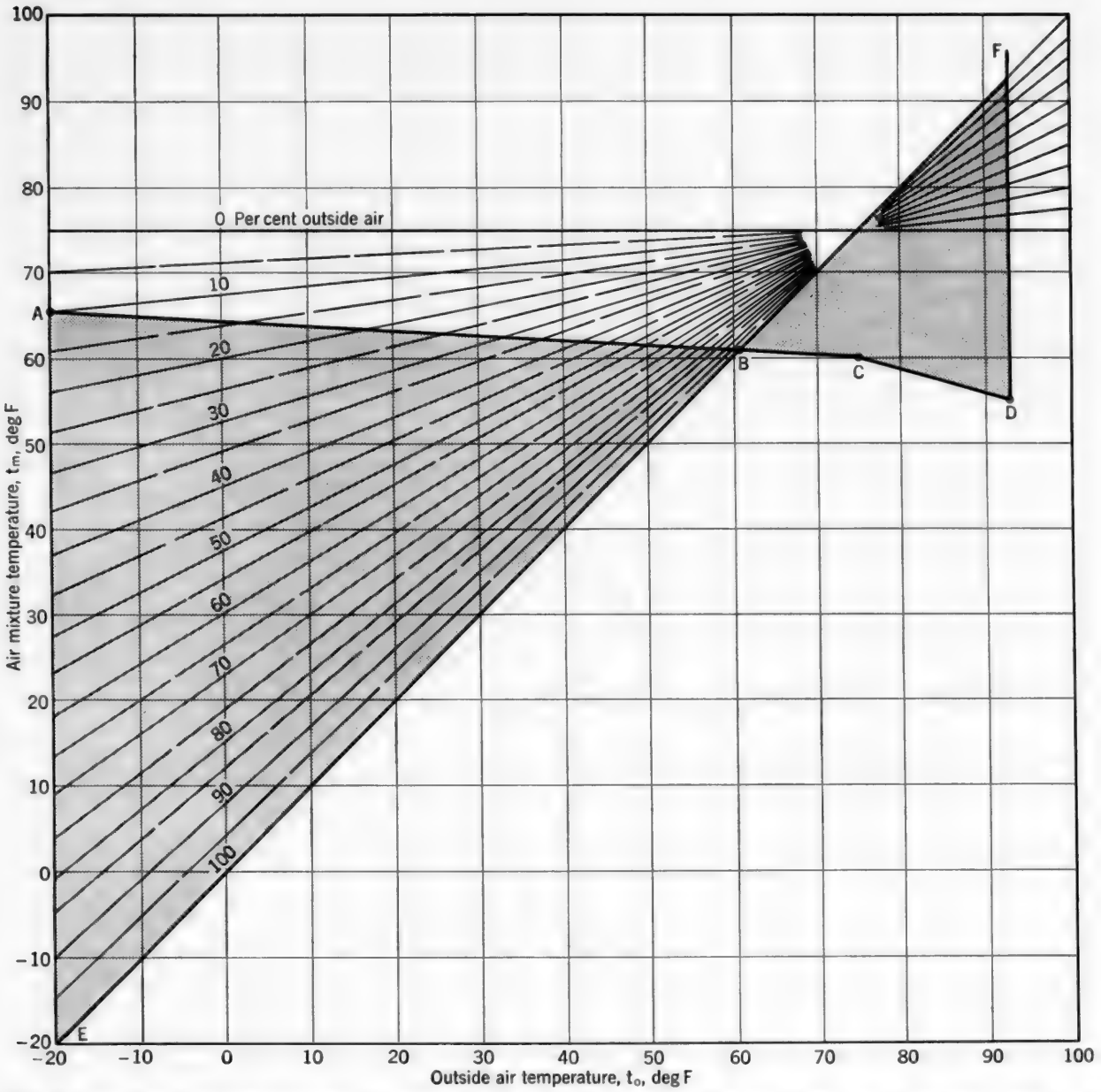


Fig. 4. Degree of heating required for a system handling 100% outside air is shown by shaded portion under line *AB*. Degree of cooling is shown above line *BCD*. Line *ACD* is the locus of those temperatures of supply air calculated to maintain constant indoor comfort as outside temperature varies throughout the year. The difference between air mixture temperatures, on lines *EBF* and *ACD*, for any given outside temperature, is the temperature rise or drop which must be handled by the heating or cooling system. Note (also Fig. 5), that room temperature is a constant 75 deg. F.

As outlined above, ventilation economies must be considered in terms of (1) containment of radioactive materials, (2) removal of particulate material, and (3) satisfaction of the occupants. So long as these conditions are met, it is permissible to reduce ventilation and thereby improve the cost as follows:

Program System Operations

Often it is possible to program the operation of ventilation systems, shutting them off during the night and weekends when regular laboratory activities are not in progress. At such times, laboratory materials may not give off harmful particulate matter. Containment alone is sufficient. Highly active materials can be stored in vaults and can be otherwise protected from possible spreading. At such times, positive directional flow of air within the room to control, and thereby remove, particulate material is not required. Also, in most cases, ventilation systems are not intended to provide area heating, inasmuch as other means, such as wall radiation, are more suitable for this purpose. Thus, when occupants are not present, the ventilation system can be shut down.

An example of an area in which the ventilation may be shut down, as just described, is one in which uranium is machined and handled, as differentiated from an area in which irradiated samples are sectioned. In the latter area, *the ventilation system cannot be shut down under any circumstances.*

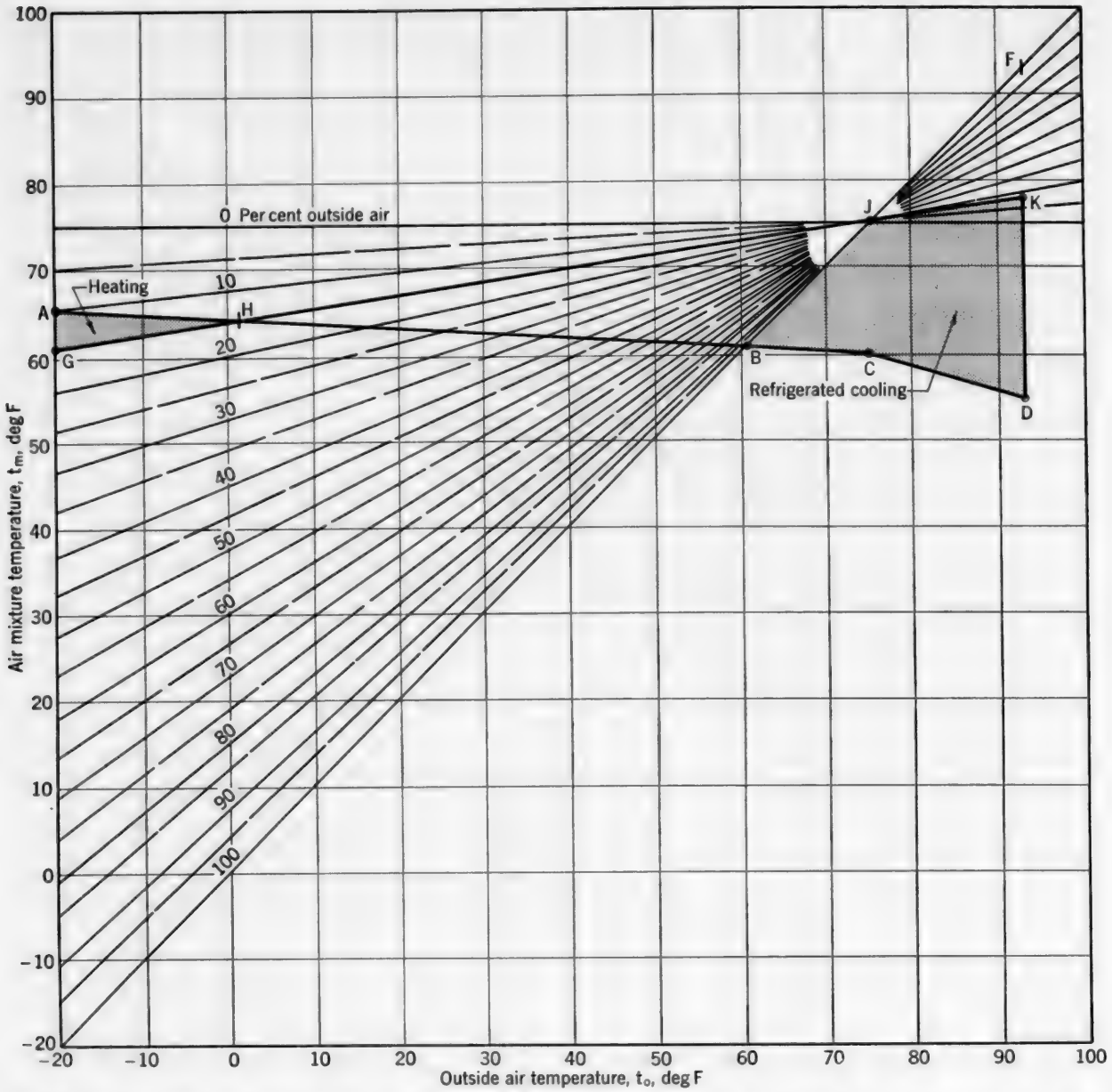


Fig. 5. How heating and cooling costs are reduced by varying the percentage of outside air. The shaded area on the left shows the degree of heating required, with outside air percentage fixed at 15%. Between *H* and *B* outside air percentage is varied from 15 to 100%, along line *HB*, to avoid the necessity of mechanical cooling. At approximately 75 deg outside temperature, shown as point J, outside air is again reduced to 15% to cut refrigerated cooling costs.

Establish Proper Air Balance Between Air Supply and Exhaust

It is important to establish efficient air balance between the supply and the exhaust systems in order to maintain proper control of radioactive materials. Air flow should be, to repeat, from non-radioactive to radioactive regions within the laboratory. Such flow minimizes the magnitude of the control velocities which would otherwise have to be higher to overcome air turbulence within the space controlled. Lower air flow quantities mean lower air heating costs. The capacity of the exhaust system should be somewhat greater than the air supply system. A small degree of infiltration from the outside or adjoining buildings (non-radioactive areas) is desirable and the difference in capacities of the two systems is made up by the infiltration. The actual amount of air flow corresponding to the infiltration should be based on control velocities somewhat lower than those at the face openings of exhaust hoods, etc. An inward velocity of 80 fpm is recommended at doors leading to the radiation areas. This corresponds to a static pressure differential across such openings of 0.0004 inches of water. Corresponding wall leakages will result.

Air flow patterns in radiological work areas are diametrically opposed to those employed in regular areas where the air makeup quantities are made to exceed the

exhaust. Radiological ventilation systems handle large quantities of air. The air supply, though lower than the exhaust, is much higher than is required for the occupancy alone. The air supplied depends primarily upon the amount of air exhausted.

Minimize Outside Air Intake

Pursuant to establishing a desirable air balance between air supply and exhaust, it is possible to reduce the outside air intake to a minimum, thereby reducing the cost of heating such air, providing the exhaust air is also reduced. It would be undesirable to reduce the air intake much below that of the exhaust air. Such a reduction would increase the infiltration rate and this could create uncomfortable drafts and interfere with the effectiveness of the exhaust hoods.

Before reducing supply air, it is first necessary to reduce the exhaust flow. In many instances, this can be done as follows:

1. Decrease the size of exhaust hood openings either on a permanent basis or by making provision for closing the hoods when not in use.
2. Provide a hood design which will cause a uniform air velocity at the face opening. Also, provide an air balancing damper to prevent the inrush of air when the hood door is being closed. (AEC air foil hood)
3. Provide air supply at the hoods where this is feasible. Air supplied at this point does not require heating. It is evident that the cost of heating air in radiological areas can best be measured by the volume of the air exhausted since the exhaust air is equal to the air introduced through the supply system plus infiltration.

The air supply, though minimized, will be relatively high and certain precautions must be followed in order to assure low operating costs. The following principles are recommended:

1. Introduce the air in a draft-free manner.
2. Employ cross-ventilation to the fullest extent by locating supply openings where the air will flush every part of the space before being exhausted except as it may be more feasible to by-pass a portion of the air (unheated) at the exhaust openings.
3. Always calculate the actual ventilation needs and reduce the air supply to match these needs subject to the exhaust needs.

By adhering to the above precautions, lower capture velocities will be possible, resulting in lower overall flow rates and costs to heat the air.

Recirculate Air When Allowable

The cost of heating air is directly proportional to the volume of outside air introduced. Often a supply-exhaust system can be redesigned to recirculate part of the air, thereby decreasing the outside air intake in an amount equal to that recirculated.

Figure 1 is an example of a system employed in a controlled area which will be converted to a system employing partial recirculation. Figure 2 shows the manner in which the author has redesigned the system to recirculate part of the air. As a second step of the redesign, Fig. 3 shows a complete conversion of the system as it will be when the area is decontrolled and completely reconverted to office use.

Control Outside Air Input For Process Area Cooling

Where large volumes of outside air are introduced on a one-pass basis, as makeup air for laboratory exhaust, such outside air quantities are generally fixed. Extreme conditions of heating during the winter and cooling during the summer prevail. Where processes allow recirculation of air and the minimum outside air is determined by the requirements of the human occupancy alone, then the maximum outside air should be controlled to satisfy the heating and cooling requirements of the space by varying the quantity of cool outside air in the mixture of outside and return air.

The air supply system sensible heat balance for a given process area can be given as shown in Fig. 4 where t_o is the outside air temperature and t_m is the air mixture temperature (of outside and return air). A calculated temperature of the air discharged into the room (same as air mixture if not heated or cooled) which will satisfy or maintain constant year-round space temperatures is plotted against outside temperature along the line *ACD*.

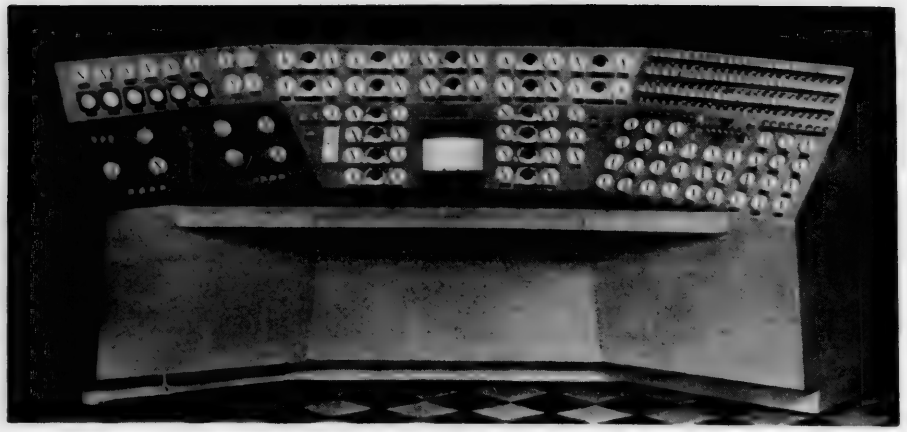
Figure 4 shows the degree of heating which is required for a system handling 100% outside air (shaded portion under line *AB*) also the sensible cooling (shaded portion over line *BCD*). For any given outside temperature, the heating, or sensible cooling is obtained by substituting the temperature rise or drop, as taken from the chart, in the expression:

$$H = 1.1\ Q\ \triangle t,$$

where H is given in Btu per hr, Q in cfm, and $\triangle t$, the temperature change, in deg F.

Line *GHJK* in Fig. 5 shows how the heating requirements are reduced when the outside air input is reduced to 15% of the total air being circulated. Heating then occurs in the area *AHG* as compared to the former *ABE*. The reduction in heating requirements, however, is accomplished at the expense of cooling. A greater amount of refrigerated cooling is required.

Refrigerated cooling must be used until the outside temperature drops as low as point *H*, as compared to the former outside temperature described by point *B*. This situation can be reduced to an economical operation by controlling the outside air as described by the line *HB*, which cuts across the percentage outside air lines, increasing the outside air as the outside temperature rises from *H* to *B*. In this way, the air mixture temperature will be that necessary to satisfy the space requirements without a need for additional heating or cooling, so long as the outside temperature remains between *H* and *B*. Thus, the heating and refrigerated cooling can be reduced to a minimum, making for the most economical operation. This operation should be made automatic in response to a space thermostat and a summer outside air insertion thermostat, together with other contributing controllers.



Model of the control center. The console is 10 ft wide, 4 ft high, and consists of a number of panels.

Mechanical Service Facilities Regulated by a Control Center

C. J. ALLEN
Associate, Albert Kahn Associated Architects and Engineers, Inc., Detroit, Mich.

An unusual and interesting feature of the new main office of the National Bank of Detroit, now under construction in down town Detroit, is the control center, designed to aid in the control and operation of the building's mechanical service facilities. This center provides for operating 83 controls and monitoring 129 indicators, including 19 alarms, through a network of over 7 miles of pneumatic control tubing and 4 miles of control wiring.

A NEW 14-story main office building for the National Bank of Detroit, presently under construction in Detroit's financial district, is the first new large-scale, privately-owned building to be erected in the downtown area in nearly three decades. It will house exclusively the facilities of this national bank, and will occupy the entire city block on which it stands.

Designed by Albert Kahn Associated Architects and Engineers, this building is modern in concept and design, friendly with its existing neighboring buildings, and fully in harmony with the architecture of Detroit's new Civic Center to which it forms the gateway. An offset arrangement, from floor to floor, of windows and porcelain panels, alternating with marble panels, creates a tapestry-like effect. At ground level, the structure's attractiveness is enhanced by a story-and-a-half arcade and recessed glass facade on the north and east sides which permits an unobstructed view of the main banking floor to passers-by.

Mechanical Equipment

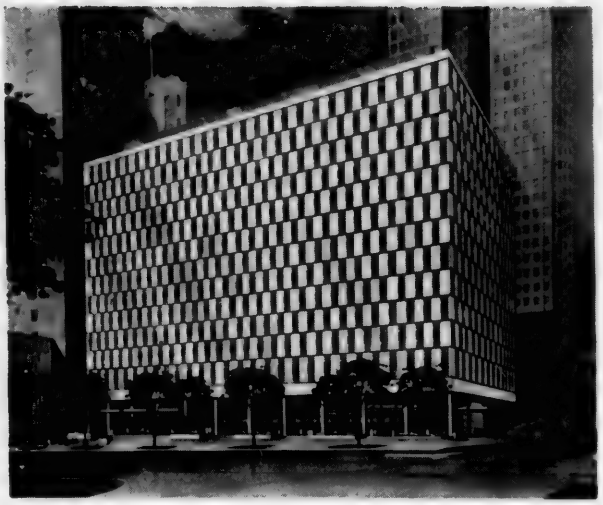
The latest engineering concepts in air conditioning, lighting and vertical transportation are incorporated in this building design. To serve its mechanical requirements, there are four strategically-located basic mechanical equipment areas, two of which are below the street at the safe deposit floor level. These two areas house the incoming steam and electrical services from the Detroit Edison Company, the incoming water service, the air conditioning and ventilating fan units and coils for the two floors below grade, and the snow-melting heat exchangers and pumps.

Located on the fourth floor is a fan room housing supply, recirculating and exhaust fans, generally serving floors from the main banking level at grade through the seventh floor. Also located on the fourth floor are the domestic hot water heaters which serve the three separate systems throughout the building.

Supply, recirculating and exhaust fans serving floors above the seventh are housed in a penthouse fan room which also contains the refrigeration compressors, chillers, chilled water pumps, condenser water pumps, cooling tower, gravity tank for fire protection, and hydro-pneumatic tank for domestic water service for the upper building floors. This floor also contains the mechanical equipment for the north and south banks of elevators.

Controls Required

To staff, supervise and maintain these widely scattered, highly integrated services in the best manner possible, would customarily require a large force with adequate means of control over these diverse functions. To accom-



Architects' drawing of the new building for the National Bank of Detroit.

plish the desired result, however, with a minimum maintenance force, a clearing house was required for basic operating data and a central control room. Consequently a control center was incorporated in the bank's design. This center is located in a room adjacent to the resident engineer's office on the fourth floor.

Extent of Operations

After establishing the desirability of a control center, it was necessary to determine the extent to which control functions would be exercised as opposed to purely monitoring functions.

Certain prime requisites of staffing demanded the presence of an operator in the penthouse during periods of operation of the refrigeration compressors. This fact dictated that the control center perform purely monitoring functions with respect to the refrigeration system. Accordingly, the following items relating to the refrigeration system are included at the control center: Chilled water supply and return temperature and pressure; condenser water supply and return temperature and supply pressure; condenser and chilled water pump operating bull's-eyes for each of the four pumps; load current meters; running time totalizers, and operating-bull's-eyes for each of three refrigeration machines and three cooling tower fans.

Because the snow melting system is a separate entity, its operation does not require that the pumps be started from the control center for they start operating automatically at a pre-selected outside temperature. Indication of their operation, however, is provided by a bull's-eye at the control center for each of the two pumps in the installation. The snow melting system is designed in such a manner that upon a forecast of snow, the temperature of the circulating glycol solution can be increased in advance of the snowfall, thus anticipating the impending demand. The manually operated high-low temperature switch controlling this action is located at the control center as a control function. The remaining monitoring functions for the snow melting system are satisfied by the presence at the control center of supply and return water thermometers and pressure gages.

Air Conditioning System Controls

Of primary practical importance from a control standpoint is the air conditioning and ventilating system. The majority of the areas of the building are air conditioned by means of 18 high velocity double duct systems, all of which are controlled at the control center. For each system there is an indicating thermometer registering both the hot and cold deck temperatures and a reset switch permitting adjustment of the hot deck temperature. To complete the temperature monitoring of the building, 9 reheat coil discharge thermometers and 24 thermometers located in general areas throughout the building may be observed at the control center.

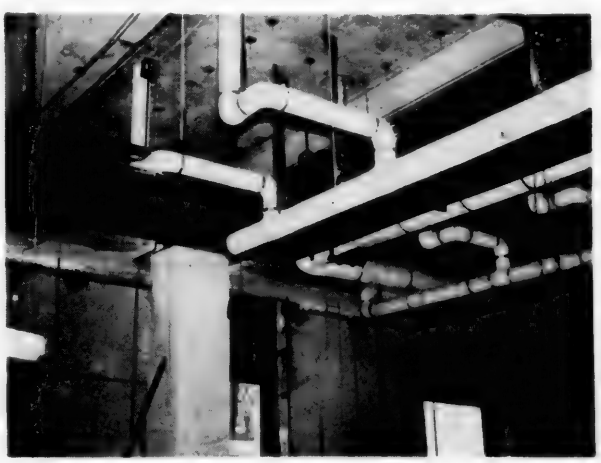
In conjunction with the air conditioning and ventilating system, the control of supply, recirculating and certain exhaust fans is provided at the control center. This fan control is accomplished by means of a group of IBM coded relays which are arranged in a series of 12 channels each having a maximum of 6 stations per channel. This permits a total of 72 relays, 57 of which are required for the present installation. By this arrangement up to six fans may be started simultaneously at one setting. Each fan, nevertheless, may be separately controlled by tripping its individual key out of the pre-selected grouping. The status of operation of each fan is indicated by a bull's-eye at the control center.

Summer-Winter Control

Three air conditioning and ventilating systems require summer cut-out switches to over-ride the low limit duct thermostats provided for winter operation. One summer-winter switch, therefore, is provided at the control center for each of the three systems.

A master summer-winter switch at the center makes possible the over-riding of the controls on the chilled water valves to all cooling coils. This switch shuts off the chilled water to each coil for winter operation, and a manual bypass switch at each individual valve permits selected coils to remain on chilled water during the winter cycle if internal heat gains in an area should require supplementary cooling.

The eighth and ninth floors are supplied through two-speed fan systems; which require damper manipulation to isolate north from south halves of the building and



Horizontal run of control tubing placed in ceiling below the control center.

eighth from ninth floors. These damper controls are operated from the control center.

Smoke exhaust damper operation from a critical meeting room on the staff floor is also under the control of the control center operator.

Incoming Services Monitored

In addition to certain basic services monitored at the control center, outside temperature is indicated on the panel as this information is of importance in evaluating the performance of the heating and air conditioning systems. The main steam supply pressure also is indicated on the panel. To establish the instantaneous steam consumption of the building, it was necessary to install two orifice meters, since the physical piping arrangement would not permit the installation of an orifice meter in the high pressure steam supply main upstream of the first pressure reducing valve location. One orifice is installed in the high pressure line, and a second orifice is installed in the medium pressure line. The sum of these two flows, representing the total usage, is shown on a miniature steam flow indicator on the panel. Low pressure steam is used in four areas, and each of these four areas is served by a pressure reducing valve station. The downstream pressure at these PRV stations is monitored at the control center.

Hot Water and Electric Services

The domestic hot water system is divided into three zones, each separately controlled, and the supply temperature to each of these zones is monitored at the control center. City water main pressure, also, is indicated on the panel.

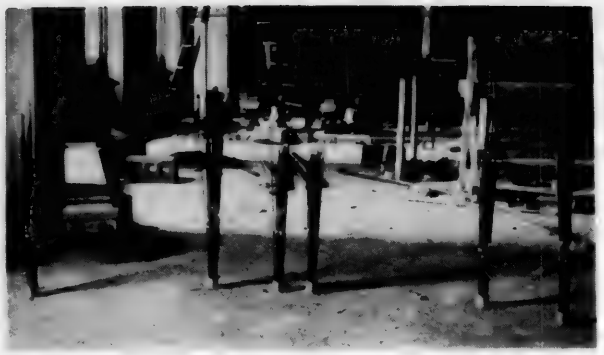
Electric service is provided normally from two sources through two double cable circuits to switchgear with automatic closing of a tie breaker if one source fails. A bull's-eye at the control center indicates when the automatic switch-over has been effected and the tie breaker is closed.

Alarm Systems

One important function of the control center is to provide a central alarm station. Alarm bull's-eyes are furnished for two smoke detectors in the recirculating ducts serving the north and south halves of the building; a jam in the sorting system of the pneumatic tube system lights a bull's-eye on the panel; alarm lights signal low water level in the gravity water storage tank and in the hydro-pneumatic tank; high water level alarms are flashed for each of the two sewage ejectors, an oil interceptor pump and 6 sump pumps; high temperature alarm lights are provided for two walk-in refrigerators in the kitchen area, also for indicating refrigeration compressor failure for the food storage freezer; and power loss to the fire protection panel is signaled by another bull's-eye.

Console Arrangement

The feeding of data to and from the center is both electrical and pneumatic. The panel size is 48 inches high, 30 inches deep and 10 feet long with all services fed through the floor. Six panel sections are arranged to provide a control center with a sloping back and wing sides to permit maximum accessibility for operation. A slide projector enables the operator to select any one



In the foreground are six sleeves through which all pneumatic controls enter the bottom of the console. Control wiring is not shown.

of fifty 35-mm slides to view diagrams of the various systems for which control and monitoring are provided.

The upper left panel groups the incoming steam pressure and city water pressure, low pressure steam pressure, refrigeration compressor running time and current meters, and snow melting system pressures and temperatures.

The lower left panel depicts graphically the refrigeration system and includes the bull's-eyes showing operation of the cooling tower fans, cooling water pumps, chilled water pumps and refrigeration compressors as well as the temperatures and pressure in the chilled and cooling water loops.

The center panels include the hot and cold deck temperatures, reset switches and auxiliary fan bull's-eyes, outside temperature, steam flow, snow melting controls, and a few alarm bull's-eyes, also the projector screen and controls.

The upper right panel includes all toggle switches and indicating lights for the fan and damper operation. The lower right panel has the alarm pilot lights mounted in two banks, the IBM selector switch for fan operation, and all indicating thermometers for special areas throughout the building. The panel is built of 3/16-inch steel sheet, welded and finished in a light grey baked enamel.

According to estimates, savings effected by the use of this control center will amortize the cost of the installation within four years. It is apparent, therefore, that the successful and economical application of centralized control to the mechanical service facilities of commercial buildings is an inevitable step in the extension of modern process controls.

Credits

Francis A. Sando, Jr., resident mechanical engineer, and T. W. Bradford, consulting engineer to the bank, worked closely with the architectural and engineering firm of Albert Kahn Associated Architects and Engineers, designers of the building, and with the Detroit office of the Johnson Service Company, builders of the controls system, in the design and development of the intricate control center system.

The contractors are J. H. Brodie & Sons, air conditioning and ventilating contractors; J. Livingston & Co., Inc., electrical contractor; Bryant & Detwiler Company, general contractor.

Time-Saving Procedure for Piping Stress Analysis

K. HAO HSIAO
Nuclear Division, Holmes & Narver, Inc.
Los Angeles, Calif.

Modern piping systems, connecting pumps, boilers, heat exchangers, and other equipment, are installed at ambient temperatures, but often operate at temperatures up to 1,000 deg F. Thermal expansions of the systems create very large forces and stresses, which, if not provided for, will result in distortion of equipment and overstressing of piping. The piping designer must provide sufficient flexibility to keep stresses below an allowable limit, but avoid an excessive flexibility that wastes material and labor. The procedure presented here is for efficient and time-saving analysis, and is based on the 1955 American Standard Code for Pressure Piping. This code contains important changes in formulae and application of flexibility factor, K; stress intensification factor, i; characteristic factor, h; controlling and allowable stress ranges; and hot and cold reactions. The author will compare his system with the more rigorous method and discuss piping systems with anchor movements in a subsequent issue of this publication.

EQUATIONS FOR FORCE RANGES

IN the piping system of Fig. 1, assume end *l* as fixed, and end *a* as tending to expand. (All piping systems will be assumed fixed at both ends, for flexibility, where forces, moments, and torques occur. However, one end of each system is shown as temporarily free to expand, in order to determine the direction for forces X, Y, and Z resisting expansion at that end. These forces are transferred to the centroid of the system, where there is no moment or torque.)

The forces X, Y, and Z, which restrain end *a* and prevent it from expanding, are transferred to the centroid of the system, in front of the *c-e-g-k* plane, forming the centroidal axes of the system, shown as dotted lines in Fig. 1. In actual computation, however, the original axes are used instead of the centroidal axes.

As shown by solid lines in Fig. 1, the original, arbitrarily chosen, axes are such that two of the axes are in a plane containing the greatest number of branches, while the third axis is colinear with a branch perpendicular to this plane. Such a selection reduces many coordinate values in Table 1-A to zero, thereby cutting down the time and labor required for calculations. The X, Y, Z forces are obtained from the following equations:[1]

$$XI_x - YI_{xy} - ZI_{xz} = \frac{\triangle_x EI}{1728} \quad (1)$$

$$-XI_{xy} + YI_y - ZI_{yz} = \frac{\triangle_y EI}{1728} \quad (2)$$

$$-XI_{xz} - YI_{yz} + ZI_z = \frac{\triangle_z EI}{1728} \quad (3)$$

[1] Superscripts refer to references at the end of the article.

NOMENCLATURE

L Length of each piping branch, ft.

x, y, z Coordinates of the centroid of each piping branch or elbow for Tables 1-A, 3-A, and 5-A, or coordinates of each point of the system in Tables 1-B, 3-B, and 5-B, with respect to the original arbitrarily chosen X, Y, and Z axes, ft.

$\bar{x}$, $\bar{y}$, $\bar{z}$ Coordinates of the centroid of the piping system with respect to the above axes, ft.

I_x, I_y, I_z Moments of inertia of the system about its centroidal axes, ft.^{3}

I_{xy}, I_{xz}, I_{yz} Products of inertia of the system about its centroidal axes, ft.^{3}

I_1, I_2, I_3 Centroidal moment of inertia of branches parallel to Z-axis, Y-axis, and X-axis, respectively, ft^3, magnified 12 times.

Δ_x, Δ_y, Δ_z Total thermal expansion of the system in the X, Y, and Z directions, respectively, inches.

E_h, E_c Modulus of elasticity of piping material at operating temperature or in the hot condition; and that at installation, or cold, condition, psi.

I Moment of inertia of the cross-sectional metal area of the pipe, in.^{4}

S Section modulus of pipe, in.^{3}

D Outside diameter of pipe, inches.

t Thickness of pipe wall, inches.

r Mean radius of pipe, inches.

T Temperature, deg F.

e Thermal expansion of pipe, inches per 100 ft of pipe, from installation to operating temperature.

R Radius of curvature of elbow or quarter bend, ft.

X, Y, Z Force ranges due to expansion, lb.

X_h, X_c Values of the X force in hot and cold conditions, lb.

M_{xy}, M_{xz}, M_{yz} Bending moments due to X, Y, and Z forces in XY, XZ, and YZ planes, ft-lb. (One of these moments is actually a torque.)

X′, Y′, Z′ Relative force range values.

M'_{xy}, M'_{xz}, M'_{yz} Relative moment values in the XY, XZ, and YZ planes.

M_f, M_n, T_f, T_n Combined bending moment ranges and torque ranges at points *f*, *n*.

h Characteristic factor.

K Flexibility factor.

L_a Actual length of elbow or quarter bend, or effective length of miter-bend, ft.

i Stress intensification factor.

α Transverse virtual length, ft.

β Differential virtual length, ft.

θ One-half angle between adjacent miter axes, deg.

c Cold spring factor.

s_b Maximum bending stress, psi.

s_t Corresponding torsional stress, psi.

f Stress range reduction factor. (f = 1 for 7,000 or less temperature cycles over expected piping life.)

s_e Expansion stress at any point of the system; maximum expansion stress of the system, i.e., controlling stress range, psi.

s_a Allowable stress range, psi.

s_h Allowable stress of pipe in hot condition, given in Code.

s_c Allowable stress of pipe in cold condition, given in Code.

I_{ox}, I_{oy}, I_{oz} Sums of centroidal moments of inertia of elbows about their own respective neutral axes, ft.^{3}

m Number of elbows in planes parallel to the axis of I_o.

n Number of elbows in planes perpendicular to the axis of I_o.

I_{oxy}, I_{oxz}, I_{oyz} Sums of centroidal products of inertia of elbows parallel to the plane of inertia, ft^3.

N Total number of elbows in a system.

N_{xy} Number of elbows parallel to XY plane.

(1) to (27) Numerals, each representing one row of figures.

(A), (B), (C) Symbols, each representing one numerical value.

(a) Symbol, representing three values, (A), (B), and (C).

(b), (c) Symbols, each representing three values.

TABLE 1-A. COEFFICIENTS FOR FORCE EQUATIONS — EXAMPLE 1

Dividing Eqs. (1) (2), and (3) by line inertias I_x, I_{xy}, and I_{xz} respectively, and using E_c for E, according to the 1955 A.S.A. Code for Pressure Piping, we obtain:

$$X - Y\frac{I_{xy}}{I_x} - Z\frac{I_{xz}}{I_x} = \frac{\triangle_x E_c I}{I_x(1728)} \qquad (4)$$

$$-X + Y\frac{I_y}{I_{xy}} - Z\frac{I_{yz}}{I_{xy}} = \frac{\triangle_y E_c I}{I_{xy}(1728)} \qquad (5)$$

$$-X - Y\frac{I_{yz}}{I_{xz}} + Z\frac{I_z}{I_{xz}} = \frac{\triangle_z E_c I}{I_{xz}(1728)} \qquad (6)$$

Calculations of line inertias in Equations (4), (5), and (6) is based on Equations (7), and operations are tabulated in Table 1-A in connection with Example 1, which follows. Solution of X, Y, and Z forces is also given in Table 1-A. Calculation of the coordinates, $\bar{x}$ and y, of the centroid of the system in the XY plane, with respect to the original axes, is based on the last two equations in Equations (7), and those in other planes are obtained in a similar manner.

Plane XY:

$$I'_x = \alpha \sum_{i=\text{all elbows}} y_i^2 + \beta \sum_{i=\text{elbows} \parallel \text{plane}} y_i^2 + \sum_{i=\text{all branches}} L_i y_i^2 + 0.3 \sum_{i=\text{branches perp. to plane}} L_i y_i^2 - \bar{y}\left[\alpha \sum_{i=\text{all elbows}} y_i + \beta \sum_{i=\text{elbows} \parallel \text{plane}} y_i + \sum_{i=\text{all branches}} L_i y_i + 0.3 \sum_{i=\text{branches perp. to plane}} L_i y_i\right] \qquad (7a)$$

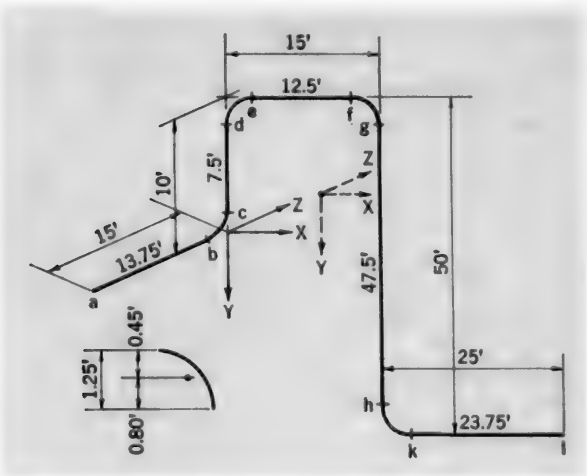
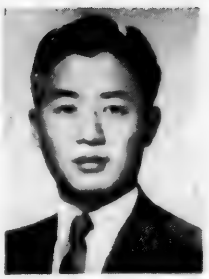


Fig. 1. Piping system of Example I.



In his present affiliation with Holmes & Narver, Inc. as structural engineer, K. Hao Hsiao has been concerned with the structural design and stress analysis of piping systems under seismic, cryogenic and high temperature conditions. He contributed significantly to one of the firm's special projects involving analysis of the effect of earthquakes on nuclear reactors. His design work has included piping stress analysis on high temperature, high-alloy piping for hydroformers and ultraformers, stainless steel and copper fuel lines for missiles which are subjected to sub-zero temperatures, dynamic stress analysis of fluid containers, and similar analysis of rocket containers under impact conditions. Mr. Hsiao received Bachelor and Master degrees in Mechanical Engineering from Stanford University, where he majored in the field of applied mechanics, and is the author of a number of technical papers on the subject of efficient piping stress analysis.

Plane YZ:

I''_z = same as above (7b)

Plane XY:

$$I'_y = \alpha \Sigma x_i^2 + \beta \Sigma x_i^2 + \Sigma L_i x_i^2 + 0.3 \Sigma L_i x_i^2 - \bar{x}\left[\alpha \Sigma x_i + \beta \Sigma x_i + \Sigma L_i x_i + 0.3 \Sigma L_i x_i\right] \qquad (7c)$$

Plane XZ:

I'_z = same as above (7d)

$$I''_x = \alpha \Sigma z_i^2 + \beta \Sigma z_i^2 + \Sigma L_i z_i^2 + 0.3 \Sigma L_i z_i^2 - \bar{z}\left[\alpha \Sigma z_i + \beta \Sigma z_i + \Sigma L_i z_i + 0.3 \Sigma L_i z_i\right] \qquad (7e)$$

Plane YZ:

I''_y = same as above (7f)

Entire System:

$$I_x = I'_x + I''_x + I_1/12 + I_2/12 \qquad (7g)$$

$$I_y = I'y + I''_y + I_1/12 + I_3/12 \qquad (7h)$$

$$I_z = I'_z + I''_z + I_2/12 + I_3/12 \qquad (7i)$$

Plane XY:

$$I_{xy} = \alpha \sum_{i=\text{all elbows}} x_i y_i + \beta \sum_{i=\text{elbows} \parallel \text{plane}} x_i y_i + \sum_{i=\text{all branches}} L_i x_i y_i + 0.3 \sum_{i=\text{branches perp. to plane}} L_i x_i y_i - y\left[\alpha \sum_{i=\text{all elbows}} x_i + \beta \sum_{i=\text{elbows} \parallel \text{plane}} x_i + \sum_{i=\text{all branches}} L_i x_i + 0.3 \sum_{i=\text{branches perp. to plane}} L_i x_i\right] \qquad (7j)$$

TABLE I-B. MOMENTS AND TORQUES — EXAMPLE I

TABLE T-A. COEFFICIENTS FOR FORCE EQUATIONS — EXAMPLE I

	DESIGNATION	X	Y	Z	L^3	L	Lx	Lx^2	Ly	Ly^2	Lz	Lz^2	Lxy	Lxz	Lyz
BRANCH // Z	ab	0	0	-8.13	2600	13.75	0	0	0	0	-111.79	909	0	0	0
	(1) SUM (= ab)				I_1										
	(2) (1) × 0.3 (= ab × 0.3)					4.13	0	0	0	0			0		
BRANCH // Y	cd	0	-5	0	421.9	7.5	0	0	-37.5	187.5	0	0	0	0	0
	gh	15	15	0	107172	47.5	712.5	10688	712.5	10688	0	0	10688	0	0
	(3) SUM				I_2 107596	55	712.5	10688	675	10876	0	0	10688	0	0
	(4) (3) × 0.3					16.5	213.8	3206			0	0		0	
BRANCH // X	ef	7.50	-10	0	1953	12.5	93.75	703.1	-125	1250	0	0	-937.5	0	0
	kl	28.13	40	0	13396	23.75	668.09	18793	950	38000	0	0	26724	0	0
	(5) SUM				I_3 15349	36.25	761.84	19496	825	39250	0	0	25786	0	0
	(6) (5) × 0.3					10.88			247.5	11775	0	0			0
ELBOWS // XY	de					L = 1	0.45	0.20	-9.55	91.20	0	0	-4.30	0	0
	fg						14.55	211.70	-9.55	91.20	0	0	-138.95	0	0
	hk						15.45	238.70	39.55	1564.2	0	0	611.05	0	0
	(7) SUM					NO ELLS 3	30.45	450.6	20.45	1746.6	0	0	467.80	0	0
	(8) (7) × β	β = 6.87				20.61	209.2	3096	140.5	11999			3214		
ELBOWS // XZ						L = 1									
	(9) SUM					NO ELLS									
	(10) (9) × β														
ELBOWS // YZ	bc					L = 1	0	0	-0.45	0.20	-0.45	0.20	0	0	0.20
	(11) SUM	(= bc)				NO ELLS 1									
	(12) (11) × β	(= bc × β)				6.87			-3.09	1.37	-3.09	1.37			1.37
	(13) (7)+(9)+(11)					4	30.45	450.6	20	1746.8	-0.45	0.20	467.80	0	0.20
	(14) (13) × α	α = 8.84				35.36	269.2	3983	176.8	15442	-3.98	1.77	4135	0	1.77
BASIC SUM	(15) (1)+(3)+(5)+(14)					140.36	1743.2	34167	1676.8	65568	-115.77	910.77	40609	0	1.77

LINE DATA: 10" Sch. 40 A 106, Gr. A

D 10.75 Δy 0.26′
t 0.365 Δz 0.0975′
I 160.7 h 0.203
S 29.9 K 8
T 900°F L_a 1.9635
e 0.0065 ft/ft i 2.60
E_h 21.5(10⁶) α 8.84′
E_c 29(10⁶) S_h 6500
Δ_x 0.26′ β 6.87′
S_c 16000

XY

(16) Σ=(2)+(8)+(15)	165.10	1952.4	37263	1817.3	77567			43823	
(17) (16) ÷ ΣL	$\bar{x}$ = 11.86		$\bar{y}$ = 11.04						
(18) (17) × Σ	$\bar{x}\Sigma Lx$ = 23155		$\bar{y}\Sigma Ly$ = 20063			$\bar{y}\Sigma Lx$ = 21554			
(19) (16) − (18)	I'_y = 14108		I'_x = 57504			I_{xy} = 22269			

XZ

(20) Σ=(4)+(10)+(15)	156.86	1957	37375		-115.8	910.77		0	
(21) (20) ÷ ΣL	$\bar{x}$ = 12.51				$\bar{z}$ = −0.74				
(22) (21) × Σ	$\bar{x}\Sigma Lx$ = 24482				$\bar{z}\Sigma Lz$ = 85.69		$\bar{z}\Sigma Lx$ = −1448		
(23) (20) − (22)	I'_z = 12893				I''_x = 825.08		I_{xz} = 1448		

YZ

(24) Σ=(6)+(12)+(15)	158.11			1921.21	77344	-118.86	912.14			3.14
(25) (24) ÷ ΣL			$\bar{y}$ = 12.18		$\bar{z}$ = −0.75				
(26) (25) × Σ			$\bar{y}\Sigma Ly$ = 23400		$\bar{z}\Sigma Lz$ = 89.15			$\bar{z}\Sigma Ly$ = −1441	
(27) (24) − (26)			I''_x = 53944		I_y = 823			I_{yz} = 1444	

COEFFICIENTS

$-\frac{I_{xy}}{I_x} = -\frac{22269}{67512} = -0.330$ Ⓐ

$-\frac{I_{xz}}{I_x} = -\frac{1448}{67512} = -0.021$ Ⓑ

$\frac{\Delta_x E_c I}{I_x 1728} = \frac{0.26(29)10^6(160.7)}{67512(144)} = 124.64$ Ⓒ ..... (a)

$\frac{I_y}{I_{xy}} = \frac{16427}{22269} = 0.738$

$-\frac{I_{yz}}{I_{xy}} = -\frac{1444}{22269} = -0.065$

$\frac{\Delta_y E_c I}{I_{xy} 1728} = \frac{0.26(29)10^6(160.7)}{22269(144)} = 377.85$ ..... (b)

$-\frac{I_{yz}}{I_{xz}} = -\frac{1444}{1448} = -1.0$

$\frac{I_z}{I_{xz}} = \frac{77082}{1448} = 53.233$

$\frac{\Delta_z E_c I}{I_{xz} 1728} = \frac{0.0975(29)10^6(160.7)}{1448(144)} = 217.914$ ..... (c)

I'_x = 57504	I'_y = 14108	I'_z = 12893		
I''_x = 825	I''_y = 823	I''_z = 53944		
$I_{1/12}$ = 217	$I_{1/12}$ = 217	$I_{1/12}$ = 8966		
$I_{\frac{1}{144}}$ = 8966	$I_{\frac{1}{144}}$ = 1279	$I_{\frac{1}{144}}$ = 1279		
I_x = 67512	I_y = 16427	I_z = 77082		

FORCES FROM COEFFICIENTS

(1)	(a)+(b)	0.408	-0.086 Ⓓ	502.49
(2)	(a)+(c)	-1.330	53.212 Ⓔ	2303.78
(3)	(2) × Ⓓ/Ⓔ	0.002 Ⓕ	-0.086	-3.72 Ⓖ
	(1)−(3)	0.406 Ⓚ		506.21 Ⓛ

$Y = \frac{Ⓛ}{Ⓚ} = \frac{506.21}{0.406} = 1246$

$Z = \frac{Ⓖ - Ⓕ Y}{-Ⓓ} = \frac{-3.72 - 0.002(1246)}{-0.086} = 72$

$\frac{Ⓓ}{Ⓔ} = \frac{-0.086}{53.212} = -0.001616$

$Y' = \frac{Y}{Z} = 17.32$, $X' = \frac{X}{Z} = 7.47$

$X = Ⓒ - Ⓐ Y - Ⓑ Z = 124.64 + 0.33(1246) + 0.021(72) = 537$

Plane XZ:

$$I_{xz} = \alpha \Sigma x_i z_i + \beta \Sigma x_i z_i + \Sigma L_i x_i z_i + 0.3 \Sigma L_i x_i z_i - \bar{z} [\alpha \Sigma x_i + \beta \Sigma x_i + \Sigma L_i x_i + 0.3 \Sigma L_i x_i] \quad (7k)$$

Plane YZ:

$$I_{yz} = \alpha \Sigma y_i z_i + \beta \Sigma y_i z_i + \Sigma L_i y_i z_i + 0.3 \Sigma L_i y_i z_i - \bar{z} [\alpha \Sigma y_i + \beta \Sigma y_i + \Sigma L_i y_i + 0.3 \Sigma L_i y_i] \quad (7l)$$

$$K = \frac{1.65}{\quad} \quad (8)$$

where

$$\alpha = 0.5 (K + 1) L_a \quad (12)$$

TABLE 1-B. MOMENTS AND TORQUES — EXAMPLE 1

	POINT	a	b	c	d	e	f	g	h	k	l
	X	0	0	0	0	1.25	13.75	15	15	16.25	40
	Y	0	0	-1.25	-8.75	-10	-10	-8.75	38.75	40	40
	Z	-15	-1.25	0	0	0	0	0	0	0	0
$\bar{x}$=11.86	x-$\bar{x}$	-11.86	-11.86	-11.86	-11.86	-10.61	1.89	3.14	3.14	4.39	28.14
$\bar{y}$=11.04	y-$\bar{y}$	-11.04	-11.04	-12.29	-19.79	-21.04	-21.04	-19.79	27.71	28.96	28.96
(1)	X'(y-$\bar{y}$)	-82.47	-82.47	-91.81	-147.83	-157.17	-157.17	-147.83	206.99	216.33	216.33
(2)	Y'(x-$\bar{x}$)	-205.42	-205.42	-205.42	-205.42	-183.77	32.73	54.38	54.38	76.03	487.38
	M'_{xy}	122.95	122.95	113.61	57.59	26.60	-189.90	-202.21	152.61	140.30	-271.05
$\bar{z}$=-0.74	z-$\bar{z}$	-14.26	-0.51	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74
(3)	X'(z-$\bar{z}$)	-106.52	-3.81	5.53	5.53	5.53	5.53	5.53	5.53	5.53	5.53
$\bar{x}^{(4)}$=12.51	x-$\bar{x}$	-12.51	-12.51	-12.51	-12.51	-11.26	1.24	2.49	2.49	3.74	27.49
	M'_{xz}	-94.01	8.70	18.04	18.04	16.79	4.29	3.04	3.04	1.79	-21.96
$\bar{z}$=-0.75	z-$\bar{z}$	-14.25	-0.50	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
(5)	Y'(z-$\bar{z}$)	-246.81	-8.66	12.99	12.99	12.99	12.99	12.99	12.99	12.99	12.99
$\bar{y}^{(6)}$=12.18	y-$\bar{y}$	-12.18	-12.18	-13.43	-20.93	-22.18	-22.18	-20.93	26.57	27.82	27.82
	M'_{yz}	234.63	3.52	26.42	33.92	35.17	35.17	33.92	-13.58	-14.83	-14.83

Plane xy

where $\alpha = 0.5\,(K+1)\,L_a \qquad \beta = 0.5\,(K-1)\,L_a$

$$\bar{y} = \left[\alpha \sum_{i=\text{all elbows}} y_i + \beta \sum_{i=\text{elbows} \parallel XY} y_i + \sum_{i=\text{all branches}} L_i y_i + 0.3 \sum_{i=\text{branches perp. to XY}} L_i y_i \right] \div \left[\alpha N + \beta N_{xy} + \sum_{i=\text{all branches}} L_i + 0.3 \sum_{i=\text{branches perp. to XY}} L_i \right] \quad (7m)$$

$$\bar{x} = \left[\alpha \sum_{i=\text{all elbows}} x_i + \beta \sum_{i=\text{elbows} \parallel XY} x_i + \sum_{i=\text{all branches}} L_i x_i + 0.3 \sum_{i=\text{branches perp. to XY}} L_i x_i \right] \div \left[\alpha N + \beta N_{xy} + \sum_{i=\text{all branches}} L_i + 0.3 \sum_{i=\text{branches perp. to XY}} L_i \right] \quad (7n)$$

It is seen, from Equations 7, that the numerical values for branches in torsion in each perpendicular plane ("branches perp. to plane") is increased 30% to take into account their torsional effect on flexibility. Such increases in flexibility are tabulated in rows (2), (4), and (6) in Table 1-A. These data apply to Example 1, discussed later.

When a piping system contains circular 90-deg elbows or quarter bends, each of these elbows contributes, to the system, greater flexibility in bending than that of its true length. This increased flexibility of elbow is accounted for by using a virtual length, KL_a, which is used in calculating line inertias in the plane of elbow. The flexibility factor, K, and the actual length of elbow, L_a, are defined below, with the condition that $K > 1$:

TABLE 1-C—CALCULATIONS FOR EXAMPLE 1

		From Tables 1-A and 1-B	Range	Hot	Cold
Multiplier		—	72	0.741	0.432
Forces	X	537	—	398	232
	Y	1246	—	923	538
	Z	72	—	53	31
Moments at α	M_{xy}	122.95	8,852	6,559	3,824
	M_{xz}	94.01	6,769	5,016	2,924
	M_{yz}	234.63	16,893	12,517	7,298
Moments at *1*	M_{xy}	271.05	19,516	14,461	8,431
	M_{xz}	21.96	1,581	1,172	683
	M_{yz}	14.83	1,068	791	461
Moments at *g*	M_{xy}	202.21	—	—	—
	M_{xz}	3.04	—	—	—
	M_{yz}	33.92	—	—	—
Controlling Stress Range, S_E (at *g*)		—	15,412	—	—

TABLE 2—CALCULATIONS FOR EXAMPLE 2— HOT CONDITION

$$h$$

$$L_a = \frac{\pi R}{2} \quad (9)$$

where the characteristic factor, h, is

$$h = \frac{12\,t\,R}{r^2} \quad (10)$$

The above elbow is completely in bending in the XY plane and only partially in XZ and YZ planes, i.e., the elbow is half in bending and half in torsion in the latter two planes. Since the flexibility factor for an elbow in torsion is unity, its virtual lengths in the XZ and YZ planes are 0.5 (K + 1) L_a. The equation for I'_x in plane XY for all elbows in the entire system is:

$$I'_x = 0.5\,(K+1)\,L_a \sum^{i=\text{elbows}\,\|\,XZ,\,YZ} y_i^3 + KL_a \sum^{i=\text{elbows}\,\|\,XY} y_i^2 - \bar{y}\left[0.5\,(K+1)\,L_a \sum^{i=\text{elbows}\,\|\,XZ,\,YZ} y_i + KL_a \sum^{i=\text{elbows}\,\|\,XY} y_i\right] = \alpha \sum^{i=\text{all elbows}} y_i^2 + \beta \sum^{i=\text{elbows}\,\|\,XY} y_i^2 - \bar{y}\left[\alpha \sum^{i=\text{all elbows}} y_i + \beta \sum^{i=\text{elbows}\,\|\,XY} y_i\right] \quad (11)$$

$$\alpha = 0.5\,(K+1)\,L_a \quad (12)$$

$$\beta = 0.5\,(K-1)\,L_a \quad (13)$$

Combining Equation (11) with I'_x for the straight branches in the system, we have the expression for I'_x in Equation (7a). The sum of the increases in flexibility for elbows in their own plane, XY, that is $\beta \sum^{i=\text{elbows}\,\|\,XY} y_i^2$ is tabulated in Row (8) of Table 1-A, and those in the other two planes are in Rows (10) and (12). The numerical values in Rows (2), (4), (6), (8), (10), and (12) result in the differential final values for each plane, tabulated respectively in Rows (16), (20), and (24). These final values are used to compute line inertias in Rows (19), (23), and (27).

It is to be noted that the x, y, and z coordinates of the centroids of elbows are tabulated in the Lx, Ly, Lz columns in the "elbows" section of Table 1-A, i.e., L = 1 for all elbows. The solution for X, Y, and Z forces in Equations (4), (5), and (6) are also included in Table 1-A.

The flexibility factor, K, the characteristic factor, h, and the effective length, L_a, of a miter bend with a 45-deg centerline are:

$$K = 1.52\,h^{-5/6} \qquad (K > 1) \quad (14)$$

$$h = 0.5\,(1 + \cot\theta)\,(t/r) \quad (15)$$

$$L_a = 0.5\,\pi\,R \quad (16)$$

where R for the miter bend is defined as:

$$R = 0.5\,(1 + \cot\theta)\,r \quad (17)$$

These formulae can be applied in Equations (7) and Table 1-A for calculations of line inertias for a system containing miter bends.

CALCULATION OF MOMENTS AND TORQUES

The values of forces, X, Y, Z, the coordinates of points on the system, x, y, z, and the centroidal coordinates of the system $\bar{x}$, $\bar{y}$, $\bar{z}$, are taken from Table 1-A and filled in Table 1-B. The relative moment values on rows (1), (2), (3), (4), (5) and (6) are calculated. The total relative moment ranges in the XY, XZ, and YZ planes are M'_{xy} = (1) − (2), M'_{xz} = (3) − (4) and M'_{yz} = (5) − (6), of which two are bending and one, torsional, for each point on the system. The greatest vector sum of the former, multiplied by the force range, Z, gives the maximum combined bending moment range of the system, and the latter, multiplied by Z, gives the corresponding torque range. The maximum relative combined bending moment for the system in Example 1 is, by inspection of Table 1-B, at point *l*, i.e.:

$$(271.05^2 + 21.96^2)^{1/2} = 271.94.$$

Hence, the maximum combined bending moment range is

$$M_l = 72\,(271.94 = 19{,}580 \text{ ft-lb.}$$

The torque range at *l* is T_l = 72 (14.83) − 1068 ft-lb.

The moment and torque ranges at *a* are

$$M_a = 72\,(94.01^2 + 234.63^2)^{1/2} = 18{,}199 \text{ ft-lb.}$$

$$T_a = 72\,(122.95) = 8852 \text{ ft-lb.}$$

Hot and Cold Forces and Moments

The forces, X, Y, and Z, and moments and torques from Tables 1-A and 1-B, are *ranges*, from which their values in hot and cold conditions can be obtained. For instance, the X force in hot and cold conditions are obtained from the following formulae:

$$X_h = (1 - 2c/3)\,(E_h/E_c)\,(X) \quad (18a)$$

$$X_c = cX \text{ or } (1 - s_h E_c/s_c E_h)\,(X) \quad (18b)$$

where $(s_h/s_c)\,(E_c/E_h) < 1$.

For the system in Example 1, the conversion factors for hot and cold reactions are:

$$E_h/E_c = 21.5/29 = 0.741 \qquad (c = 0)$$

$$(1 - s_h E_c/s_c E_h) = 1 - (6{,}500/15{,}412)\,(29/21.5) = 0.432$$

TABLE 2—CALCULATIONS FOR EXAMPLE 2— HOT CONDITION

		At Anchor *a*		Ratio, Author's to Rigorous* Method	At Anchor *f*		Ratio, Author's to Rigorous* Method
		Author's Method	Rigorous* Method		Author's Method	Rigorous* Method	
Forces	X	1,827	1,750	1.04	1,827	1,750	1.04
	Y	1,753	1,720	1.02	1,753	1,720	1.02
	Z	624	640	0.98	624	640	0.98
Moments	M_{xy}	11,556	11,090	1.04	5,248	5,280	0.99
	M_{xz}	948	1,200	——	7,090	6,710	1.06
	M_{yz}	4,717	4,670	1.01	8,450	7,920	1.07
Controlling Stress Range, S_e, at *a*		15,330	14,760	1.04	——	——	——

* Calculated by Kellogg's Method with electronic computer.

PIPE STRESS

The expansion stress, s_e, at any point in a system, based on E_c and full expansion, is defined in the Code:

$$s_e = (s_b^2 + 4s_t^2)^{1/2} \qquad (19a)$$

$$s_b = \frac{iM}{S} \qquad (19b)$$

$$s_t = \frac{T}{2S} \qquad (19c)$$

where the stress intensification factor, i, is defined as follows for elbow, circular bend, and miter bend, with the condition that it is greater than unity:

$$i = 0.9/h^{2/3} \qquad (20)$$

The maximum value of s_e, the controlling stress range, shall not exceed the allowable stress range, s_a, defined in the Code:

$$s_a = f(1.25\, s_c + 0.25\, s_h) \qquad (21)$$

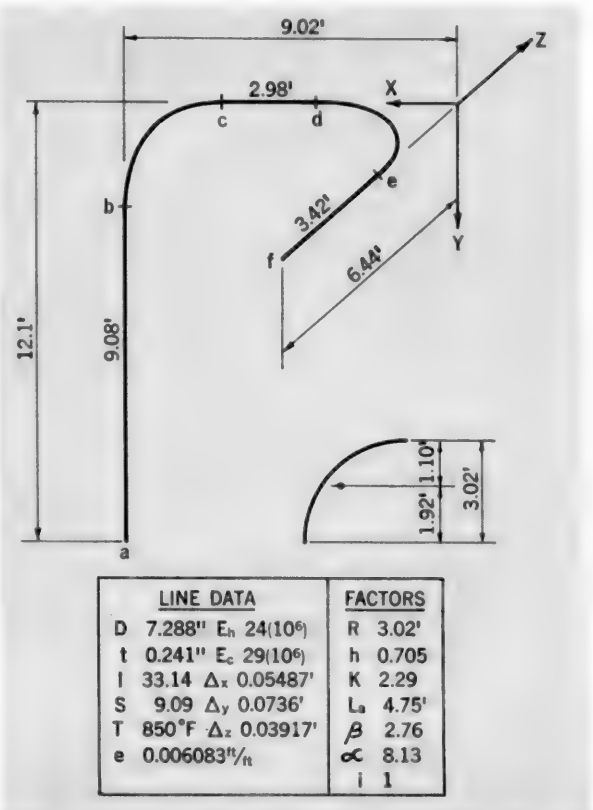
For the effect of pressure and weight on expansion stress, the reader is referred to the Code.

In Example I, although the maximum moment is at *l*, the controlling stress range is at *g*. This is due to the stress intensification factor at *g*. Assuming f = 1 and substantial pressure and weight stresses, the controlling stress range, s_e, and allowable stress range, s_a, are calculated as follows:

$$M_g = 72\,(202.21^2 + 33.92^2)^{1/2} = 14{,}762 \text{ ft-lb.}$$
$$T_g = 72\,(3.04) = 219 \text{ ft-lb.}$$
$$s_b = iM/S = 2.60\,(14{,}762)\,12/29.9 = 15{,}404 \text{ psi}$$
$$s_t = T/2S = 219\,(12)/2\,(29.9) = 44 \text{ psi}$$
$$s_e = [15{,}404^2 + 4\,(44^2)\,]^{1/2} = 15{,}412 \text{ psi}$$
$$s_a = 1.25\,(16{,}000) + 0.25\,(6500) = 21{,}625 \text{ psi} > 15{,}412 \text{ psi}$$

Therefore, the system in Fig. 1 is not overstressed.

The procedure for computing force and moment ranges (Tables 1-A and 1-B) and controlling stress range, Equations (19), on the basis of E_c and full expansion range is equivalent to computing the forces, moments, and stresses as if the line had been cold sprung 100%. These values represent the ranges, or a conservative estimate of, the sums of hot and cold forces, moments, and controlling stresses in the system.



LINE DATA				FACTORS	
D	7.288"	E_h	24(10⁶)	R	3.02'
t	0.241"	E_c	29(10⁶)	h	0.705
l	33.14	Δ_x	0.05487'	K	2.29
S	9.09	Δ_y	0.0736'	L_a	4.75'
T	850°F	Δ_z	0.03917'	β	2.76
e	0.006083"/ft			α	8.13
				i	1

Fig. 2. Piping system of Example II.

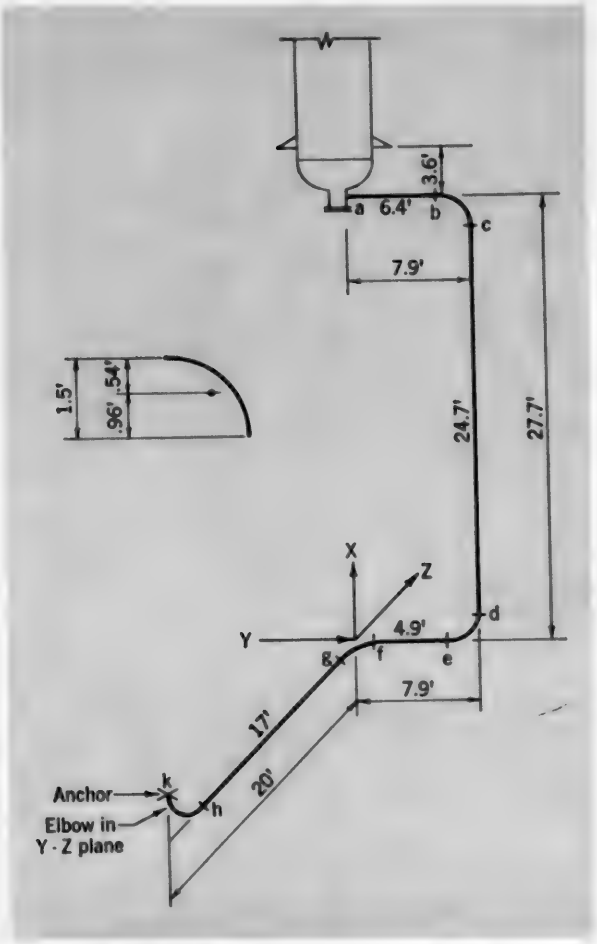


Fig. 3. Piping system of Example III.

The use of allowable stress range as the limit for controlling stress range, and the computation of maximum hot and cold forces and moments from their respective ranges, based on E_c and 100% expansion, are deduced from the phenomenon of "self-springing," resembling cold springing: the relaxation of initially high stresses in the hot condition and the creation of reversed stresses in the cold condition. This phenomenon is explained in Markl's excellent paper *Piping Flexibility Analysis*[2].

Example I

The piping system in Fig. 1 is analyzed in this example. The line data and the calculations of coefficients and force ranges are given in Table 1-A. The relative moments and torques are computed in Table 1-B. Moments, torques, and hot and cold reactions are calculated in Table 1-C.

Example II

In this example, the present procedure is applied to the piping system as shown in Fig. 2. Since the tabulation and calculation are the same as in Example I, only the numerical results are shown in Table 2.

Example III

In this example, the piping system in Fig. 3 is analyzed. The moments and torques at anchors *a* and *k*, and the point of maximum bending moment, *d*, are obtained from the data in Table 3-B, as follows:

$$M_a = 575\ (12.67^2 + 4.73^2)^{1/2} = 7774 \text{ ft-lb}$$
$$T_a = 575\ (10.43) = 5997 \text{ ft-lb}$$
$$M_k = 575\ (5.08^2 + 14.63^2)^{1/2} = 8901 \text{ ft-lb}$$
$$T_k = 575\ (0.47) = 270 \text{ ft-lb}$$
$$M_d = 575\ (7.33^2 + 15.77^2)^{1/2} = 9999 \text{ ft-lb}$$
$$T_d = 575\ (3.17) = 1823 \text{ ft-lb.}$$

The controlling stress range at point *d*:

$$i = 0.9/(0.082)^{2/3} = 4.77$$
$$s_b = 4.77\ (9999)\ (12)/22 = 26{,}016 \text{ psi}$$
$$s_t = 1823\ (12)/(2)\ (22) = 497 \text{ psi}$$
$$s_e = (26{,}016^2 + 4 \times 497^2)^{1/2} = 26{,}035 \text{ psi}$$

Since this value of s_e is only slightly greater than the allowable stress range, s_a, obtained as follows, the piping system may be assumed to be adequate stress-wise:

$$s_h = 6600 \text{ psi}$$
$$s_c = 18{,}750 \text{ psi}$$
$$s_a = 1.25\ (18{,}750) + 0.25\ (6600) = 25{,}100 \text{ psi.}$$

The numerical results are tabulated in Table 3-C, where the two multipliers are conversion factors for hot and cold reactions, which are used in Equations 18, and are obtained as follows:

$$(1 - 2c/3)\ (E_h/E_c) = 21.6/27.4 = 0.788 \quad (c = 0)$$
$$1 - (s_h/s_e)\ (E_c/E_h) = (6600/26{,}035)\ (27.4/21.6) = 0.678$$

Example IV

The procedure presented here is applied to the example problem in *Piping Design and Engineering*, page 62, by the Grinnell Company. The original data on page 62 of the above book are listed below, and are used to calculate Δ_x, Δ_y, Δ_z, α and β. Computations of force, relative moment, and torque ranges are the same as previous examples, so the corresponding tables are omitted. The computations of forces, moments, torques and bending stress s_b, based in E_h instead of E_c, as is done in the Grinnell book, are also given below. The comparison of the numerical results with those by Grinnell are given in Table 4. The piping system is shown in Fig. 4.

Size: 10", Sch. 40
Material: A-106, Gr. A
$t = 0.365$
$I = 160.8$
$S = 29.9$
$T = 750°$ F
$e = 6.08''/100'$
$E_h = 24.82 \times 10^6$
$\Delta_x = 14\ (0.0608) = 0.8512$
$\Delta_y = 12\ (0.0608) = 0.7296$
$\Delta_z = 18\ (0.0608) = 1.0944$
$X = 804, Y = 511, Z = 866$

TABLE 3-A. COEFFICIENTS FOR FORCE EQUATIONS — EXAMPLE III

	DESIGNATION	x	y	z	L^3	L	Lx	Lx^2	Ly	Ly^2	Lz	Lz^2	Lxy	Lxz	Lyz
BRANCH ‖ Z	gh	0	0	-10	4,913	17	0	0	0	0	-170	1700	0	0	0
(1)	SUM				I_1 4,913	17	0	0	0	0	-170	1700	0	0	0
(2)	(1)×0.3					5.1	0	0	0	0			0		
BRANCH ‖ Y	ab	27.7	3.2	0	262.1	6.4	177	4900	20.5	65.5	0	0	566	0	0
	ef	0	3.95	0	117.6	4.9	0	0	19.4	76.5	0	0	0	0	0
(3)	SUM				I_2 379.7	11.3	177	4900	39.9	142.0	0	0	566	0	0
(4)	(3)×0.3					3.4	53.1	1470			0	0		0	
BRANCH ‖ X	cd	13.85	7.9	0	15069	24.7	342.0	4740	195.2	1543	0	0	2700	0	0
(5)	SUM				I_3 15069	24.7	342.0	4740	195.2	1543	0	0	2700	0	0
(6)	(5)×0.3					7.4			58.6	463	0	0			0
ELBOWS ‖ XY	bc					L=1	27.16	737	7.36	54.2	0	0	200	0	0
	de						.54	.3	7.36	54.2	0	0	4	0	0
(7)	SUM					No. ells 2	27.70	737.3	14.72	108.4	0	0	204	0	0
(8)	(7)×β					45.2	62.5	16,680	333	2450			4610		
ELBOWS ‖ XZ	hK					L=1	-.54	.3	0	0	-19.46	378	0	10.5	0
(9)	SUM					No. ells 1	-.54	.3	0	0	-19.46	378	0	10.5	0
(10)	(9)×β					22.6	-12.2	7			-440	8540		237.3	
ELBOWS ‖ YZ	fg					L=1	0	0	.54	.3	-.54	.3	0	0	-.3
(11)	SUM					No. ells 1	0	0	.54	.3	-.54	.3	0	0	-.3
(12)	(11)×β					22.6			12.2	7	-12.2	7			-7
(13)	(7)+(9)+(11)					4	27.16	737.6	15.26	108.7	-20	378.3	204	10.5	-.3
(14)	(13)×α					99.5	675	18400	380	2705	-498	9410	5,080	261.5	-7.5
BASIC SUM	(15) (1)+(3)+(5)+(14)					152.5	1,194	28,040	615.1	4390	-668	11,120	8,346	261.5	-7.5

LINE DATA: 12" DIAM. SCH. 10S STAINLESS TYPE 304

D	12.75"	Δ_y	0
t	0.180"	Δ_z	2.62"
I	140.5	h	0.082
S	22	K	20.1
T	1125 °F	L_a	2.35'
e	13.1 in/100'	i	4.77
E_h	21.6×10^6	α	10.6(2.35) = 24.9'
E_c	27.4×10^6	β	9.6(2.35) = 22.6'
Δ_x	4.1"		

Y-X	(16)	Σ=(2)+(8)×(15)	202.8	1,819	44,720	948.1	6,840			12,956	
	(17)	(16)÷ΣL		$\bar{x}$ 8.97		$\bar{y}$ 4.67					
	(18)	(17)×Σ		$\bar{x}\Sigma Lx$ 16,310		$\bar{y}\Sigma Ly$ 4,430			$\bar{y}\Sigma Lx$ 8,510		
	(19)	(16)−(18)		I'_y 28,410		I'_x 2,410			I_{xy} 4,446		
Z-X	(20)	Σ=(4)+(10)×(15)	178.5	1,234.9	29,517			-1,108	19,660	498.8	
	(21)	(20)÷ΣL		$\bar{x}$ 6.92				$\bar{z}$ -6.2			
	(22)	(21)×Σ		$\bar{x}\Sigma Lx$ 8550				$\bar{z}\Sigma Lz$ 6880	$\bar{z}\Sigma Lx$ -7670		
	(23)	(20)−(22)		I'_z 20,967				I''_x 12,780	I_{xz} 8,168.8		
Z-Y	(24)	Σ=(6)+(12)×(15)	182.5			685.9	4860	-680.2	11,127		-14.5
	(25)	(24)÷ΣL				$\bar{y}$ 3.76	$\bar{z}$ -3.73				
	(26)	(25)×Σ				$\bar{y}\Sigma Ly$ 2,580		$\bar{z}\Sigma Lz$ 2540		$\bar{z}\Sigma Ly$ -2,560	
	(27)	(24)−(26)				I''_z 2,280		I''_y 8587		I_{yz} 2,545.5	

COEFFICIENTS

$-\frac{I_{xy}}{I_x} = -\frac{4,446}{15,632} = -.284$ Ⓐ $-\frac{I_{xz}}{I_x} = -\frac{8,169}{15,632} = -.523$ Ⓑ $\frac{\Delta_x E_c I}{I_x 1728} = \frac{4.32(27.4)10^6(140.5)}{15,632(1,728)} = 616$ Ⓒ ----(a.)

$\frac{I_y}{I_{xy}} = \frac{38,664}{4,446} = 8.7$ $-\frac{I_{yz}}{I_{xy}} = -\frac{2,546}{4,446} = -.573$ $\frac{\Delta_y E_c I}{I_{xy} 1728} = 0$ ----(b)

$-\frac{I_{yz}}{I_{xz}} = -\frac{2,546}{8,169} = -.312$ $\frac{I_z}{I_{xz}} = \frac{24,530}{8,169} = 3$ $\frac{\Delta_z E_c I}{I_{xz} 1728} = \frac{2.64(27.4)10^6(140.5)}{8,169(1,728)} = 720$ ----(c)

I'_x	2,410	I'_y	28,410	I'_z	20,967			
I''_x	12,780	I''_y	8,587	I''_z	2,280			
$I_{1/2}$	410	$I_{1/2}$	410	$I_{1/2}$	32			
$I_{2/2}$	32	$I_{2/2}$	1,257	$I_{2/2}$	1,257			
I_x	15,632	I_y	38,664	I_z	24,536			

FORCES FROM COEFFICIENTS

(1)	(a)+(b)	8.416	-1.096 Ⓓ	616
(2)	(a)+(c)	-.596	2.477 Ⓔ	1,306
(3)	(2)×$-\frac{D}{E}$	-.264 Ⓕ	1.096	591 Ⓖ
(1)	+(3)	8.152 Ⓚ	0	1,207 Ⓛ

$X' = \frac{X}{Z} = 1.67$

$Y' = \frac{Y}{Z} = 0.26$

$Y = \frac{Ⓛ}{Ⓚ} = \frac{1,207}{8.152} = 148$

$Z = \frac{Ⓖ - Ⓕ Y}{-Ⓓ} = \frac{591 + .264(148)}{1.096} = 575$

$X = Ⓒ - Ⓐ Y - Ⓑ Z = 616 + .284(148) + .523(575) = 959$

FACTORS:

$\Delta_x = 0.328(13.19) = 4.32$ $\Delta_z = 0.20(131) = 26.4$

$h = 12(0.18)1.5/\left(\frac{12.75 - 0.18}{2}\right)^2 = 0.082$

$K = 1.65/0.082 = 20.1$, $i = \frac{0.9}{(.082)^{3/8}} = 4.77$

K = 2.39 (bc, fg)
= 7.01 (de)

R = 4.16 (bc, fg)
= 1.25 (de)

α = 7.54 (bc, fg)
= 2.26 (de)

β = 8.08 (bc, fg)
= 11.51 (de)

i = 1.03 (bc, fg)
= 2.52 (de)

TABLE 3-B. MOMENTS AND TORQUES — EXAMPLE III

	POINT	a	b	c	d	e	f	g	h	k
	x	27.7	27.7	26.2	1.5	0	0	0	0	-1.5
	y	0	6.4	7.9	7.9	6.4	1.5	0	0	0
	z	0	0	0	0	0	0	-1.5	-18.5	-20
$\bar{x}$ = 8.97	x-$\bar{x}$	18.73	18.73	17.23	-7.47	-8.97	-8.97	-8.97	-8.97	-10.47
$\bar{y}$ = 4.67	y-$\bar{y}$	-4.67	1.73	3.23	3.23	1.73	-3.17	-4.67	-4.67	-4.67
(1)	X'(y-$\bar{y}$)	-7.80	2.89	5.39	5.39	2.89	-5.29	-7.80	-7.80	-7.80
(2)	Y'(x-$\bar{x}$)	4.87	4.87	4.48	-1.94	-2.33	-2.33	-2.33	-2.33	-2.72
	M'_{xy}	-12.67	-1.98	0.91	7.33	5.22	-2.96	-5.47	-5.47	-5.08
$\bar{z}$ = -6.2	z-$\bar{z}$	6.20	6.20	6.20	6.20	6.20	6.20	4.70	-12.30	-13.80
(3)	X'(z-$\bar{z}$)	10.35	10.35	10.35	10.35	10.35	10.35	7.85	-20.54	-23.05
$\bar{x}$ = (4) 6.92	x-$\bar{x}$	20.78	20.78	19.28	-5.42	-6.92	-6.92	-6.92	-6.92	-8.42
	M'_{xz}	-10.43	-10.43	-8.93	15.77	17.27	17.27	14.77	-13.62	-14.63
$\bar{z}$ = -3.73	z-$\bar{z}$	3.73	3.73	3.73	3.73	3.73	3.73	2.23	-14.77	-16.27
(5)	Y'(z-$\bar{z}$)	0.97	0.97	0.97	0.97	0.97	0.97	0.58	-3.84	-4.23
$\bar{y}$ = (6) 3.76	y-$\bar{y}$	-3.76	2.64	4.14	4.14	2.64	-2.26	-3.76	-3.76	-3.76
	M'yz	4.73	-1.67	-3.17	-3.17	-1.67	3.23	4.34	-0.08	-0.47

At *a*,

$$M = 866\ (10.92^2 + 12.76^2)^{1/2} = 14{,}549 \text{ ft-lb}$$

$$T = 866\ (4.36) = 3776$$

At *h*,

$$M = 866\ (8.04^2 + 11.38^2)^{1/2} = 12{,}055 \text{ ft-lb}$$

$$T = 866\ (7.06) = 6114$$

$$s_b = [12\ (866)\ (2.52)/29.9]\ (8.48^2 + 6.51^2)^{1/2} = 9372 \text{ psi.}$$

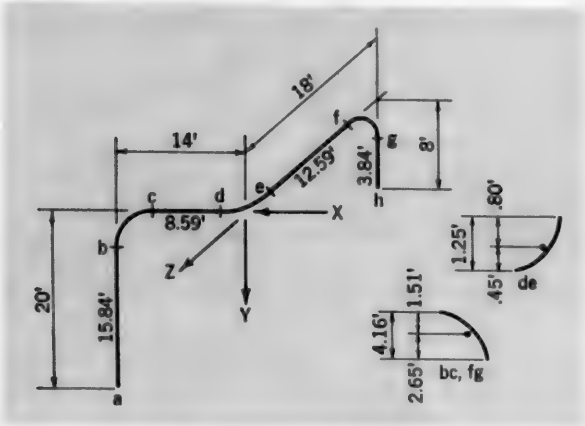


Fig. 4. Piping system of Example IV.

TABLE 3-C — CALCULATIONS FOR EXAMPLE 3

		Range	Hot	Cold
Multiplier		—	0.788	0.678
Forces	X	959	756	650
	Y	148	117	100
	Z	575	453	390
At *a*	Moment	7774	6126	5271
	Torque	5997	4726	4066
At *k*	Moment	8901	7014	6035
	Torque	270	213	183
At *d*	Moment	9999	—	—
	Torque	1823	—	—
Controlling Stress		26,035	—	—

TABLE 4—CALCULATIONS FOR EXAMPLE 4—HOT CONDITION

		Author's Procedure	Grinnell Procedure	Ratio
Forces	X	804	811	0.99
	Y	511	514	0.99
	Z	866	874	0.99
At *a*	Moment	14,549	14,700	0.99
	Torque	3,776	3,820	0.99
At *h*	Moment	12,055	12,160	0.99
	Torque	6,114	6,170	0.99
At *e*,	S_b	9,372	9,460	0.99

TABLE 5-A. COEFFICIENTS FOR FORCE EQUATIONS — EXAMPLE V

		DESIGNATION	x	y	z	L^3	L	Lx	Lx^2	Ly	Ly^2	Lz	Lz^2	Lxy	Lxz	Lyz
BRANCH // Z		ab	0	0	-5.75	614	8.5	0	0	0	0	-48.9	281	0	0	0
	(1)	SUM				I_1										
	(2)	(1) x 0.3					2.55	0	0	0	0			0		
BRANCH // Y		cd	0	5	0	343	7	0	0	35	175	0	0	0	0	0
		gh	10.5	5	0	343	7	73.5	772	35	175	0	0	367.5	0	0
	(3)	SUM				I_2 686	14	73.5	772	70	350	0	0	367.5	0	0
	(4)	(3) x 0.3					4.2	22.05	231.6			0	0		0	
BRANCH // X		ef	5.25	10	0	422	7.5	39.4	206.7	75	750	0	0	394	0	0
		km	46	0	0	314,432	68	3128	143,888	0	0	0	0	0	0	0
	(5)	SUM				I_3 314,854	75.5	3167.4	144,095	75	750	0	0	394	0	0
	(6)	(5) x 0.3					22.7			22.5	225	0	0			0
ELBOWS // XY		de						0.54	0.29	9.46	89.5	0	0	5.11	0	0
		fg					L = 1	9.96	99.20	9.46	89.5	0	0	94.22	0	0
		hk						11.04	121.90	0.54	0.29	0	0	5.96	0	0
	(7)	SUM					NO. ELLS 3	21.54	221.40	19.46	179.3	0	0	105.29	0	0
	(8)	(7) x β	β = 4.54				13.62	97.79	1005.2	88.35	814.02			478.02		
ELBOWS // XZ																
							L = 1									
	(9)	SUM					NO. ELLS									
	(10)	(9) x β														
ELBOWS // YZ		bc						0	0	0.54	0.29	-0.54	0.29	0	0	-0.29
							L = 1									
	(11)	SUM					NO. ELLS 1									
	(12)	(11) x β					4.54			2.45	1.32	-2.45	1.32			-1.32
	(13)	(7)+(9)+(11)					4	21.54	221.4	20	179.6	-0.54	0.29	105.3	0	-0.29
	(14)	(13) x α	α = 6.90				27.60	148.63	1527.66	138	1239.24	-3.73	2.00	726.57	0	-2.00
GRAND SUM	(15)	(1)+(3)+(5)+(14)					125.6	3389.63	146,395	283	2339.24	-52.63	283	1488.07	0	-2.00

LINE DATA
12", Sch. 80
A 106, Gr. B.

D	12.75	Δy	0
t	0.687	Δz	0.312
I	475	h	0.34
S	74.5	K	4.85
T	450°F	L_2	2.36
e	3.12"/100'	i	1.85
E_h	26.7(10⁶)	α	6.90
E_c	27.9(10⁶)	β	4.54
Δx	2.5"		

XY	(16)	Σ = (2)+(8)+(15)	141.77	3487.42	147,406	371.35	3153.26			1966.09		
	(17)	(16) ÷ ΣL		$\bar{x}$ = 24.6		$\bar{y}$ = 2.62						
	(18)	(17) x Σ		$\bar{x}\Sigma Lx$ = 85,791		$\bar{y}\Sigma Ly$ = 972.94			$\bar{y}\Sigma Lx$ = 9137.04			
	(19)	(16) - (18)		I'_y = 61,609		I'_x = 2180.32			I_{xy} = -7171			
XZ	(20)	Σ = (4)+(10)+(14)	129.8	3411.68	146,627			-52.63	283		0	
	(21)	(20) ÷ ΣL		$\bar{x}$ = 26.28				$\bar{z}$ = -0.41				
	(22)	(21) x Σ		$\bar{x}\Sigma Lx$ = 89,659				$\bar{z}\Sigma Lz$ = 21.58		$\bar{z}\Sigma Lx$ = -1399		
	(23)	(20) - (22)		I'_z = 56,968				I''_x = 261.42		I_{xz} = 1399		
YZ	(24)	Σ = (16)+(12)+(15)	152.84			307.95	256.58	-55.08	289.32			-3.32
	(25)	(24) ÷ ΣL				$\bar{y}$ = 2.01		$\bar{z}$ = -0.36				
	(26)	(25) x Σ				$\bar{y}\Sigma Ly$ = 618.98		$\bar{z}\Sigma Lz$ = 19.83			$\bar{z}\Sigma Ly$ = -110.86	
	(27)	(24) - (26)				I''_z = 1946.58		I_y = 269.49			I_{yz} = 107.54	

COEFICIENTS

$-\frac{I_{xy}}{I_x} = -\frac{-7171}{2549} = 2.81$ Ⓐ $-\frac{I_{xz}}{I_x} = -\frac{1399}{2549} = -0.55$ Ⓑ $\frac{\Delta_x E_c I}{I_x 1728} = \frac{2.5(27.9)10^6(475)}{2549(1728)} = 7522$ Ⓒ ..... (a)

$\frac{I_y}{I_{xy}} = \frac{88162}{-7171} = -12.29$ $-\frac{I_{yz}}{I_{xy}} = -\frac{108}{-7171} = -0.02$ $\frac{\Delta_y E_c I}{I_{xy} 1728} = \frac{\quad}{\quad} = 0$ ..... (b)

$-\frac{I_{yz}}{I_{xz}} = -\frac{108}{1399} = -0.08$ $\frac{I_x}{I_{xz}} = \frac{85210}{1399} = 60.91$ $\frac{\Delta_z E_c I}{I_{xz} 1728} = \frac{.312(27.9)10^6(475)}{1399(1728)} = 1710$ ..... (c)

I'_x = 2180 I'_y = 61609 I'_z = 56968
I''_x = 261 I''_y = 264 I''_z = 1947
$I_{y/12}$ = 51 $I_{1/12}$ = 51 $I_{z/12}$ = 57
$I_{x/12}$ = 57 $I_{y/12}$ = 26238 $I_{z/12}$ = 26238
I_x = 2549 I_y = 88162 I_z = 85210

FORCES FROM COEFFICIENTS

$X' = \frac{X}{Z} = 54$

$Y' = \frac{Y}{Z} = -4.39$

(1)	(a)+(b)	-9.48	-0.53 Ⓓ	7522
(2)	(a)+(c)	2.73	60.36 Ⓔ	9232
(3)	(2) x Ⓓ/Ⓔ	-0.02 Ⓕ	-0.53	-81 Ⓖ
(1)-(3)		-9.46 Ⓚ	0	7603 Ⓛ

$Y = \frac{Ⓛ}{Ⓚ} = \frac{7603}{-9.46} = -804$

$Z = \frac{Ⓖ - Ⓕ Y}{-Ⓓ} = \frac{-81 + 0.02(-804)}{-0.53} = 183$

$\frac{Ⓓ}{Ⓔ} = \frac{-0.53}{60.36} = -0.00878$

$X = Ⓒ - Ⓐ Y - Ⓑ Z = 7522 - 2.81(-804) + 0.55(183) = 9882$

TABLE 5-B. MOMENTS AND TORQUES — EXAMPLE V

	POINT	a	b	c	d	e	f	g	h	k	l	m
	X	0	0	0	0	1.5	9	10.5	10.5	12		80
	Y	0	0	1.5	8.5	10	10	8.5	1.5	0		0
	Z	-10	-1.5	0	0	0	0	0	0	0		0
$\bar{x}$=24.6	x-$\bar{x}$	-24.6	-24.6	-24.6	-24.6	-23.1	-15.6	-14.1	-14.1	-12.6		55.40
$\bar{y}$=2.62	y-$\bar{y}$	-2.62	-2.62	-1.12	5.88	7.38	7.38	5.88	-1.12	-2.62		-2.62
(1)	X'(y-$\bar{y}$)	-141.48	-141.48	-60.48	317.52	398.52	398.52	317.52	-60.48	-141.48		-141.48
(2)	Y'(x-$\bar{x}$)	107.99	107.99	107.99	107.99	101.41	68.48	61.90	61.90	55.31		-243.21
	M'_{xy}	-249.47	-249.47	168.47	209.53	297.11	330.04	255.62	-122.38	-196.79		101.73
$\bar{z}$=-.41	z-$\bar{z}$	-9.59	-1.09	0.41	0.41	0.41	0.41	0.41	0.41	0.41		0.41
(3)	X'(z-$\bar{z}$)	-517.86	-58.86	22.14	22.14	22.14	22.14	22.14	22.14	22.14		22.14
$\bar{x}$=26.28 (4)	x-$\bar{x}$	-26.28	-26.28	-26.28	-26.28	-24.78	-17.28	-15.78	-15.78	-14.28		53.72
	M'_{xz}	-491.58	-32.58	48.42	48.42	46.92	39.42	37.92	37.92	36.42		31.58
$\bar{z}$=-.36	z-$\bar{z}$	-9.64	-1.14	0.36	0.36	0.36	0.36	0.36	0.36	0.36		0.36
(5)	Y'(z-$\bar{z}$)	42.32	5.00	-1.58	-1.58	-1.58	-1.58	-1.58	-1.58	-1.58		-1.58
$\bar{y}$=2.01 (6)	y-$\bar{y}$	-2.01	-2.01	-0.51	6.49	7.99	7.99	6.49	-0.51	-2.01		-2.01
	M'yz	44.33	7.01	-1.07	-8.07	-9.57	-9.57	-8.07	-1.07	0.43		0.43

The present procedure and Grinnell procedure are both based on Spielvogel's method, which has been widely used in this country. Therefore, the author's results should be exactly the same as the Grinnell results. The 1% deviations shown in Table 4 are not due to errors in either procedure. It is due to the arithmetic discrepancies, occurring in any two long, continuous and parallel procedures of computation. Repeating the same calculations would iron out such discrepancies, and make the two sets of results *exactly the same.*

Example V

In this example, the author applies his method to the piping system in Fig. 5. The moment and torque ranges, and the controlling stress range at *a*, are obtained from the values of X, Y, and Z in Table 5-A, and the relative values in Table 5-B, as follows:

$$M_a = 183\ (491.58^2 + 44.33^2)^{1/2} = 90{,}323 \text{ ft-lb}$$
$$T_a = 183\ (249.47) = 45{,}653 \text{ ft-lb}$$
$$s_b = 1.3\ (90{,}323)\ (12)/74.5 = 18{,}913 \text{ psi}$$
$$s_t = 45{,}653\ (12)/(2)\ (74.5) = 3677 \text{ psi}$$
$$s_o = (18{,}913^2 + 4 \times 3677^2)^{1/2} = 20{,}292 \text{ psi}$$

A comparison of the numerical results with results obtained by the rigorous method, computed electronically, is given in Table 5-C.

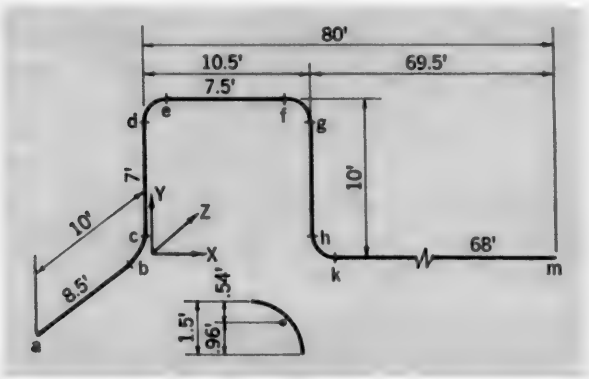


Fig. 5. Piping system of Example V.

TABLE 5-C—COMPARISON OF RESULTS, EXAMPLE 5

		Author's Method	Rigorous Method	Ratio
Force Ranges	X	9,882	9,900	1.0
	Y	804	820	0.98
	Z	183	220	(insignificant)
Moment Ranges at *a*	Resultant	9,920	9,940	1.0
	M_a (inch—lb)	1,083,000	1,062,000 (inch—lb)	1.02
	T_a	548,000	550,790	1.00
Controlling Stress Range	Resultant	1,212,231	1,197,100	1.01
		20,292	19,970	1.02

CENTROIDAL MOMENTS AND PRODUCTS OF INERTIA OF ELBOWS AND BENDS

Applying the factors, K and $(K + 1)/2$ to the formulae for centroidal line inertias of elbows in Spielvogel's book, we obtain the following values for the elbow in Fig. 6:

In the XY plane:

$$I_{ox} = 0.149\,KR^3 \quad (24a)$$

$$I_{oy} = 0.149\,KR^3 \quad (24b)$$

$$I_{oxy} = 0.137\,KR^3 \quad (24c)$$

In the XZ and YZ planes:

$$I_{oz} = 0.149\,[(K+1)/2]\,R^3 \quad (24d)$$

It is seen from Equations (24) that for any circular 90-deg elbow, each of the centroidal moments of inertia about its own centroidal axes in its own plane is $0.149\ KR^3$ and the total centroidal moment of inertia about the third axis perpendicular to its own plane is $0.149\ (K + 1)\ R^3$. The centroidal product of inertia in its own plane is $0.137\ KR^3$. Therefore, the summarized expressions for centroidal line inertia values for the entire system, when there is more than one elbow having the same radius of curvature, R, are:

$$I_{ox} = I_{oy} = I_{oz} = 0.149\,R^3\,[Km + (K + 1)\,n] = 0.149\,R^3\,[KN + n] \quad (25a)$$

$$I_{oxy} = I_{oxz} = I_{oyz} = 0.137\,KR^3\,\Sigma \pm \text{ signs}. \quad (25b)$$

The selection of sign for Equations (25) depends upon the positive directions of centroidal axes of each elbow parallel to the plane of the line inertia (which is the same as the positive directions of the axes of the piping system). When only the positive direction of one centroidal axis cuts through the elbow circle, the term $0.137\ KR^3$ is a positive value; otherwise, it is negative. Therefore, Equation (25b) is the algebraic sum of all $\pm\ 0.137\ KR^3$ values for elbows parallel to the plane of XY, XZ, or YZ (for I_{oxy}, I_{oxz}, or I_{oyz}, respectively) i.e., $\Sigma \pm$ signs is the algebraic sum of all the positive and negative signs of products of inertia for elbows parallel to plane of XY, XZ, or YZ.

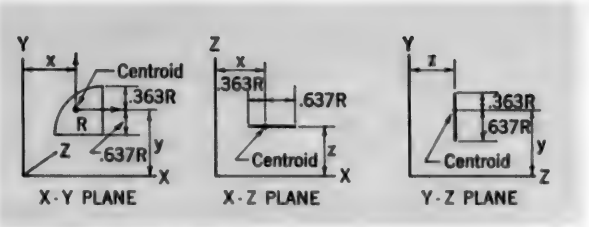


Fig. 6. Elbows in three planes.

Take, for instance, the elbow in the XY plane, Fig. 6. Since, in this case, the positive direction of only one centroidal axis of the elbow in the XY plane cuts through the elbow circle, we use $+\ 0.137\ KR^3$. When the numbers of positive and negative signs are equal, the sum of products of inertia for that plane equals zero. In this case, it is not necessary to calculate, regardless of the total number of elbows in that plane.

Applying Equations (25) to the system in Fig. 1, we have:

$$I_{ox} = 0.149\,(1.25)^3\,[8\,(4) + 1] = 9.6$$

$$I_{oy} = 0.149\,(1.25)^3\,8\,(4) = 9.3$$

$$I_{oz} = 0.149\,(1.25)^3\,[8\,(4) + 3] = 10.2$$

$$I_{oxy} = 0.137\,(8)\,1.25^3 = 2.14$$

$$I_{oxz} = 0$$

$$I_{oyz} = -0.137\,(8)\,1.25^3 = -2.14.$$

Since the above values are negligible in comparison with the total line inertias in Table 1-A of Example 1, they are not included in Table 1-A. However, when the radius of curvature, R, is large, or when distances between elbows are small, it may be necessary to calculate the summarized centroidal line inertias and add them to total line inertias obtained in Table 1-A.

ALLOWABLE VALUES

Assuming that *a* of the system in Fig. 3 is at the nozzle of a piece of equipment, the numerical values of hot and cold forces, moments and torques at *a* must be kept below allowable values in order to avoid distortion of the equipment. Two sets of approximate allowable values have been suggested by Rossheim-Markl and Wolosewick in the absence of suitable manufacturer's data or applicable experience. [3, 4, 5] Pumps and turbines are especially sensitive to thrusts and distorting moments exerted by attached piping, so special care must be exercised in limiting the magnitudes of these reactions.

The maximum combined bending moment in the system should also be kept within allowable limits, in order to prevent leakage at valves, flanges, and other joints. An alternative is to place these joints at points of low moment.

In addition to the above requirements, the piping engineer must see to it that the piping material is not overstressed beyond its allowable range at any point of the system. This is accomplished by keeping the value of s_e below s_a, as explained previously.

To fulfill the above design requirements, the piping system must possess sufficient flexibility to minimize the detrimental effects of thermal expansion, especially for the large-diameter, high-alloy piping at the higher temperatures.

SELF-CHECKING WAY OF LOCATING CENTROIDS

In piping stress calculations, tabulation (as in Tables 1-A, 3-A, and 5-A) of correct x, y, and z coordinates for each branch and each elbow of the system is of the utmost importance. The accuracy of the coordinates can be assured as soon as their numerical values are tabulated by the following "self-checking way." For instance, for the system in Fig. 1, starting from end "a," the location of the centroid of each branch or elbow is calculated as shown in Table 6.

This self-checking way of locating centroids can also be applied in Tables 1-B, 3-B, and 5-B for the tabulation of x, y, and z coordinates for points *a* to *l* inclusive. In addition to saving time and labor, without sacrificing accuracy, there are the following advantages for the procedure presented here:

1. The proportion of simplification increases with the number of branches and elbows. Increase in branches only increases the numerical values under headings *Branches* and *Elbows* and does not affect the remaining portion of Tables 1-A, 3-A, and 5-A. Thus, if the number of branches and elbows is increased from seven to fourteen, the only change in the table is the tabulation of seven additional rows of numerical values.
2. It is not necessary to locate in three perpendicular planes (in addition to an isometric view): (a) the true centroidal axes of the piping system, (b) the coordinates with respect to these axes of individual centroids of different piping branches and elbows (for calculation of line inertia values), and (c) the coordinates of ends and joints between the piping branches (for calculation of moments and torques). The analyst requires only a simple isometric view, where such locations are unnecessary.
3. It is not necessary to carry out computations for line inertias in three different tables for three perpendicular planes. One table suffices.

All of the above advantages reduce chances for errors.

Example VI

In this example, a single-plane system subjected to expansion perpendicular to its own plane is analyzed. This system is the same as that portion in the XY plane of the system in Fig. 3, except (1) *fg* is changed to a straight branch, 18 inches long, and (2) the end, *g*, is connected to a large-diameter header at the same temperature and anchored at a distance 20 ft away from *g* in the Z-direction. If this connection is a welding tee, the stress intensification factor at the connection is:

$$i = 0.9/h^{2/3} \qquad (26)$$

where $h = 4.4t/r$.

For expansion, the above system is fixed at the anchors, but for flexibility, it is assumed to be fixed at points *a* and *g*, due to the great stiffness of the header.

Equating $I_{xz} = I_{yz} = 0$ in Equations (4), (5), and (6), we have:

$$X - Y\,(I_{xy}/I_x) = (\triangle_x\, E_c\, I/1728\, I_x) \qquad (27)$$

$$-X + Y\,(I_y/I_{xy}) = (\triangle_y\, E_c\, I/1728\, I_{xy}) \qquad (28)$$

$$Z\, I_z = (\triangle_z\, E_c\, I/1728) \qquad (29)$$

It is seen from Equations (27), (28), and (29) that the force acting in the direction of Z-axis is independent of expansions in the plane of the system, and the forces acting in the same plane are also independent of expansion along Z-axis. To obtain line inertias in the above equations, we use Table 7, which is a modified version of Table 3-A.

Substituting the coefficients from Table 7 in Equations (27), (28), and (29) we have:

$$X + .056\,Y = 36{,}850$$
$$-X - 1467\,Y = 0$$
$$13{,}503\,Z = 5{,}840{,}000$$
$$Z = 432 \text{ lb}$$
$$Y = -25 \text{ lb}$$
$$X = 36{,}850 \text{ lb}$$

TABLE 6. CALCULATION OF THE LOCATION OF CENTROIDS IN FIG. 1.

	x or L_x		y or L_y		z or L_z	
ab, bc, cd	0		ab	0		−15.00
de	0.45		bc	−0.45		6.87
	0.80			−0.80	ab	−8.13
	6.25			−3.75		6.88
ef	7.50		cd	−5.00		−1.25
	6.25			−3.75		0.80
	0.80			−0.80	bc	−0.45
fg	14.55		de, fg	−9.55		0.45
	.45			−0.45	"c" to "l"	0 (Check)
gh	15.00 (Check)		ef	−10.00 (Check)		
	0.45			25.00		
hk	15.45		gh	15.00		
	0.80			23.75		
	11.87			0.80		
kl	28.12		hk	39.55		
	11.88			.45		
	40.00 (check)		kl	40.00 (Check)		

Thus, by reducing the flexibility of a three-dimensional system to that of a single-plane system, while maintaining the same expansion in three directions, the force X becomes prohibitively large. The negative sign of the Y force indicates that its direction is opposite to that assumed. The above values for X, Y, and Z are force ranges, from which the moment ranges and the hot and cold forces, moments, and torques can be calculated in a manner similar to that in Examples I and III.

If end *g* of the above system is fixed with respect to translatory motions, but is free to rotate, then it is like a hinged end. In this case, the X, Y, and Z axes, shown in Fig. 3, are also the final axes, thus eliminating the necessity of calculating $\bar{x}$, $\bar{y}$, and z. Table 7 is then reduced to Table 8, which indicates greater line inertia values or greater flexibility, resulting in smaller expansion forces.

Similar changes in Table 1-A or 3-A will adapt it to a three-dimensional system with one end hinged. This is accomplished by eliminating Lx, Ly, and Lz columns and reducing XY, XZ, and YZ tables to nine line inertia values, i.e., I'_x, I'_y, I'_z, I''_x, I''_y, I''_z, I_{xy}, I_{xz}, I_{yz}.

SPECIAL CASES

Eliminating Rows (2), (4), and (6) and those portions of Table 7 under headings "XZ" and "YZ," and changing row (7) to (7) = (5) × KL_a, we obtain a table for calculating I_x, I_y, and I_{xy} for any single-phase system not subjected to expansion perpendicular to its own plane. Substituting the above line inertias in Equations (27) and (28), we can solve for the forces X and Y, which equal the X and Y forces obtained for the system in Table 7. Thus, Table 1-A, 3-A, or 5-A, when reduced to the form of Table 7, provides a tabulation procedure for the particular case in Example 6 or in other similar cases. When reduced further, Table 7 provides a means of tabulation for any simple, single-plane system.

Eliminating that portion under headings *Elbows*, Table 1-A, 3-A, or 5-A is transformed into a simpler form for an approximate solution for a system assumed to be square-cornered.

TABLE 7. LINE INERTIA CALCULATIONS — EXAMPLE VI

		DESIG.	X	Y	L^3	L	Lx	Lx^2	Ly	Ly^2	Lxy	TABLE 1 ROW NO.
BRANCHES ‖ Y		ab	27.7	3.2	202.1	6.4	177	4900	20.5	65.5	566	
		ef	0	3.95	117.6	4.9	0	0	19.4	76.5	0	
		fg	0	.75	3.4	1.5	0	0	1.1	.8	0	
	(1)	SUM			I_2 = 383.1	12.8	177	4900	41.0	142.8	566	(3)
	(2)	0.3×SUM				3.8	53.1	1470				(4)
BRAN. ‖ X		cd	13.85	7.9	15069	24.7	342	4740	195.2	1543	2700	
	(3)	SUM			I_3 = 15069	24.7	342	4740	195.2	1543	2700	(5)
	(4)	0.3×SUM				7.4			58.6	463		(6)
ELBOWS ‖ XY		bc					27.16	737	7.36	54.2	200	
		de					.54	.3	7.36	54.2	4	
	(5)	SUM				No. OF ELLS 2	27.70	737.3	14.72	108.4	204	(7)
	(6)	(5)×β				45.2	625	16680	333	2450	4610	(8)
	(7)	(5)×α				49.8	690	18,370	366.5	2700	5080	(14)
BASIC SUM	(8)	(1)+(3)+(7)				87.3	1209	28,010	602.7	4386	8346	(15)
						132.5	1834	44,690	935.7	6836	12,956	(16)
							$\bar{x}$ = 13.85		$\bar{y}$ = 7.07			(17)
							$\bar{x}\sum Lx$ = 25,400		$\bar{y}\sum Ly$ = 6620	12,970	= $\bar{y}\sum Lx$	(18)
							I'_y = 19,290		I'_x = 216	−14	= I_{xy}	(19)
						91.1	1262.1	29480				(20)
							$\bar{x}$ = 13.85					(21)
							$\bar{x}\sum Lx$ = 17,500					(22)
							I_z = 11,980					(23)
						94.7			661.3	4849		(24)
									$\bar{y}$ = 6.98			(25)
									$\bar{y}\sum Ly$ = 4615			(26)
									I''_z 234			(27)

I'_x = 216
$I_{2/12}$ = 32
I_y = 248
I'_y = 19,290
$I_{3/12}$ = 1,257
I_y = 20,547
I'_z = 11,980
I''_z = 234
$I_{2/12}$ = 32
$I_{3/12}$ = 1,257
I_z = 13,503

COEFFICIENTS

$$-\frac{I_{xy}}{I_x} = -\frac{-14}{248} = .056$$

$$\frac{I_y}{I_{xy}} = \frac{20,547}{-14} = -1467$$

$$\frac{\Delta_x E_c I}{I_x 1728} = \frac{4.1(27.4)10^4(1405)}{248\,(1728)} = 36,850$$

$$\frac{\Delta_y E_c I}{I_{xy} 1728} = 0$$

$$\frac{\Delta_z E_c I}{1728} = \frac{2.62(27.4)10^4(1405)}{1728} = 5.84(10^6)$$

TABLE 8. SINGLE-PLANE SYSTEM CALCULATIONS

		DESIGNATION	X	Y	L^3	L	Lx^2	Ly^2	Lxy
Y BRANCHES		ab	27.7	3.2	262.1	6.4	4,900	65.5	566
		ef	0	3.95	117.6	4.9	0	76.5	0
		fg	0	0.75	3.4	1.5	0	.8	0
	(1)	SUM			I_2= 383.1		4,900	142.8	566
	(2)	(1)×0.3					1,470		
X BRANCH		cd	13.85	7.9	15,069	24.7	4,740	1,543	2,700
	(3)	SUM			I_3= 15,069		4,740	1,543	2,700
	(4)	(3)×0.3						463	
XY ELBOWS		bc	27.16	7.36			737	54.2	200
		de	0.54	7.36		L=1	0.3	54.2	4
	(5)	SUM					737.3	108.4	204
	(6)	(5)×β	β = 22.6				16,680	2,450	4610
	(7)	(5)×α	α = 24.9				18,370	2,700	5,080
	(8)	(1)+(3)+(7)					28,010	4,386	8346

I'_x	6,836	I'_y	44,690	XY	(6)+(8)	I'_y 44,690	I'_x 6,836 $\frac{1}{2}$ 2956 I_{xy}
$I_2/12$	32	$I_3/12$	1,257	XZ	(2)+(8)	I'_z 29,480	
I_x	6,868	I_y	45,947	YZ	(4)+(8)	I''_z 4,849	

I'_z	29,480
I''_z	4,849
$I_2/12$	32
$I_3/12$	1,257
I_z	35,618

COEFFICIENTS

$$-\frac{I_{xy}}{I_x} = -\frac{12,956}{6,868} = -1.88 \qquad \frac{\Delta_x E_c I}{I_x 1728} = \frac{4.1(27.4)10^6(140.5)}{6,868\,(1,728)} = 1,330$$

$$\frac{I_y}{I_{xy}} = \frac{45,947}{12,956} = 3.54 \qquad \frac{\Delta_y E_c I}{I_{xy} 1728} = 0$$

$$\frac{\Delta_z E_c I}{1728} = \frac{2.62(27.4)10^6(140.5)}{1728} = 584 \times 10^6$$

If the elbows of the system in Fig. 4 are changed to miter bends, all the numerical values above row (14) of Table 3-A, calculated for Example III, can be used with the insertion of new values for rows (8), (10), and (12). These new values are calculated, using a new β factor, obtained as follows:

Applying Equations (12), (13), (14), (15), (16), (17), and (20) to the piping in Fig. 4, we have:

$$h = [(1 + \cot 22.5°)/2]\,[0.180/6.285] = 0.0489$$
$$K = (1.52)\,[(.0489)^{1/2}]^{1/3}/.0489 = 18.8$$
$$R = (6.285)\,[(1 + \cot 22.5°)/2] = 0.9 \text{ ft}$$
$$L_a = \pi\,(0.9)/2 = 1.41 \text{ ft}$$
$$\alpha = [(18.8 + 1)/2]\,[1.41] = 13.95 \text{ ft}$$
$$\beta = [(18.8 - 1)/2]\,[1.41] = 12.55 \text{ ft}$$
$$i = 0.9/(0.0489)^{2/3} = 6.75$$

The above interchangeable use of numerical data in Table 3-A is based on the assumption that the location of centroid of each miter bend is close to that of its corresponding elbow.

When the piping system contains branches and elbows with different cross-sectional moments of inertia I_1, I_2, I_3, . . . I_n, of which the number of branches with I_n is predominant, then we apply ratios I_n/I_1, I_n/I_2, . . . I_n/I_{n-1} to the lengths and centroidal line inertias of members with cross-sectional moments of inertia other than I_n, and substitute I_n for I in Table 1-A. For instance, let branch *ab* of the system in Fig. 4 be changed to 10-inch diameter, Schedule 10S ($I = 76.9$ in.^{4}). Since, in this case the number of 12-inch pipes is predominant, we apply the ratio $140.5/76.9 = 1.83$ and obtain the following values:

$$L_{ab} = 1.83 \times 6.4 = 11.7 \text{ ft}$$
$$I_z = 1.83 \times 262.1 + 117.6 = 597.6 \text{ ft}^3$$

Replacing values for branch *ab* in Table 3-A of Example III with the above values, we obtain the tabular solution for this piping system.

Changes in the formulae and application of the flexibility factor, K, and stress intensification factor, *i*, are two of the most significant code changes published in the 1955 ASA Code for Pressure Piping. Such changes may well re-occur in future codes, but the tables presented in this article are still applicable. For instance, if the flexibility factor for bending is changed from K to K_1, and that for torsion, from unity to K_2, then the new transverse and differential virtual lengths are

$$\alpha = [(K_1 + K_2)/2]\,L_a$$
$$\beta = [(K_1 - K_2)/2]\,L_a$$

These factors would then be applied to Tables 1-A, 3-A, etc., for calculations of line inertias.

References

1. *Piping Stress Calculations Simplified*, Spielvogel, W. S.
2. *Piping Flexibility Analysis*, Transactions of the ASME, Vol. 77, No. 2, Feb. 1955.
3. *Design of Piping Systems*, M. W. Kellogg Co., Table 3.5, p. 84.
4. *The Significance of, and Suggested Limits for, the Stress in Pipe Lines Due to the Combined Effects of Pressure and Expansion*, D. B. Rossheim and A. R. C. Markl, Trans. ASME, Vol. 62, 1940, pp. 443-460.
5. *Equipment Stresses Imposed by Piping*, F. E. Wolosewick, Petroleum Refiner, Aug. 1950, pp. 89-91.

Modern Technique for

Unit Ventilator Control

JOHN SCHWARTZ
Field Engineer, Barber-Colman Company
Rockford, Illinois

The author outlines the many advantages inherent in placing the temperature sensing element for control of a unit ventilator within the unit enclosure. How the sampling chamber makes this possible is explained.

WITHIN recent years manufacturers of unit ventilators have adopted a refinement in temperature control which permits the thermostatic temperature sensing element to be located within the unit ventilator enclosure. As unit ventilator manufacturers made provisions in their equipment for unit mounting of thermostats, sensing elements were developed so that the many advantages inherent in this type of control could be realized in practice. Since unit ventilators find their most frequent application in school classrooms, one of the obvious advantages of combining the thermostatic sensing element with the unit ventilator is the avoidance of damage to the thermostat by accidental contact with objects being carried, or otherwise propelled. Opportunities for tampering with the thermostat are not present when it is enclosed in the unit ventilator. As will be explained, discomfort and increased operating cost through overheating caused by maladjustment are avoided, although proper adjustment by authorized persons is readily accomplished.

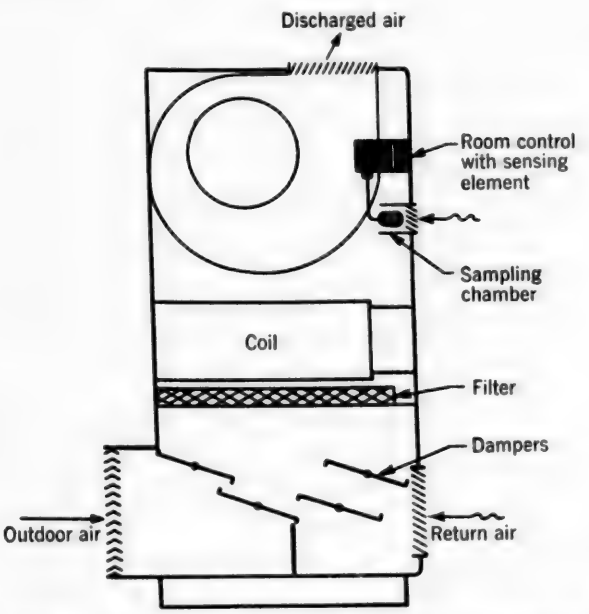
The principle on which operation of the unit ventilator mounted thermostat is based is not new. For years industrial process control engineers successfully maintained conditions of temperature and humidity in the processing room within close tolerances, utilizing this same technique. In essence, the method used for precise control is that of mounting the sensing element in a small, insulated chamber through which a representative sample of room air is forced by aspiration or some other means. The sampling chamber in modern unit ventilator equipment provides the location for optimum performance of the temperature control sensing element. There is no opportunity for unrelated problems, such as blending with room decor or location near lighting switches, to adversely affect the decision on where to place the thermostat.

Thermostat location at the unit in a properly designed sampling chamber is not to be confused with return air control. While return air control does have application under certain conditions, it is generally not suitable for unit ventilator control since the usual location of the return air grille is at the bottom of the unit, near the floor, where air temperature is not representative of the average room temperature.

A properly located sampling chamber will be in the front of the unit ventilator, 14 to 18 inches above the floor. Sensing of room air temperature is at the approximate occupancy level of the seated students. Influence of floor surface temperature on the thermostatic sensing element is eliminated.

All recirculated room air is continuously drawn to the unit ventilator by action of the fan. A representative sample of this room air passes over the thermostatic element in the sampling chamber, which is close to the suction side of the fan. Changes in the heating or cooling requirements of the room quickly reach the control element because of the mechanically forced return of all recirculated air to the unit. Therefore, minor changes in room temperature are detected, and correction may be made by the unit ventilator equipment before the change becomes great enough to be noticed by persons in the room.

Fast response by the unit-mounted thermostat is also achieved by virtue of its location in a moving air stream, because heat transfer between any fluid and a surface is a function of the velocity of the fluid passing over the surface.



Sketch of typical unit ventilator showing thermostat and sampling chamber.

Thermostatic elements located within the unit ventilator are singularly free of artificial influences. For instance, where temperatures are reduced during the night or at other periods of no occupancy, the walls enclosing the space cool off and do not regain the temperature of the air in the space until the heating system has been in operation for several hours after start-up. The sensing element mounted in a unit ventilator sampling chamber is not influenced by this cold wall effect.

Sensing elements properly designed for unit ventilator mounting are also immune to chalk dust and other micro-particles commonly present in classrooms.

Unit mounting of thermostats reduces installation costs by elimination of connections and pipe or conduit chases in floors or walls, between thermostat and unit ventilator. The cost of mounting the sensing element in the unit ventilator is generally less than that of field mounting a wall type thermostat.

Only in the less common situations where unit ventilators are ceiling hung, or located outside the classroom that it heats and ventilates, is it better to use a room thermostat rather than an element mounted in a sampling chamber in the unit ventilator. The reason for this is that samples of air taken outside the classroom space, or at the ceiling, are not likely to be representative of conditions within the classroom at the level of occupancy.

Whenever unit ventilators are applied, it is likely that advantages, both operational and economic, can be realized through use of a unit mounted element sensing space temperature.

What Is Odor?

Odor is a property attributable to matter and capable of stimulating the human sense of smell. This definition, according to John S. Nader, U. S. Public Health Service, specifies two interdependent aspects of odor measurement, namely, *measurements of matter* and *measurements of human perception.*

Measurement of matter consists of a determination of the amount of material with which an odor is directly associated, he told the Industrial Hygiene Foundation. A substance possessing an odor is called an odorant, and the above measurement is correctly called odorant measurement or more specifically measurement of odorant concentration. This measurement employs a quantitative analytical technique using chemical methods such as oxidation, or physical methods such as surface adsorption, surface tension, or infrared absorption. The results of these measurements are expressed as mass concentration of the odorant in a solid, liquid, or gaseous medium.

In contrast, *detection* of odor is known only by the response of the human sense of smell. Measurement of this response is a perceptual measurement made in terms of one or more of the following perceptual characteristics: intensity, quality, acceptability, and pervasiveness.

Measurement of matter ultimately relies upon reference to an odor standard to ascertain the perceptual aspects of the odorant. Conversely, a perceptual measurement to be conclusive must be correlated to a measurement of matter. This interdependence of matter and perceptual measurements makes it necessary to have *both* measurements for a complete evaluation of an odor.

Many "odor measurement" apparatus, thought to be instruments which give perceptual measurements, actually are devices designed to deliver known concentrations of odorants to human subjects for subsequent perceptual measurements, Mr. Nader points out. These apparatus operate on the dilution principle and differ mainly in their details of construction.

Perceptual characteristics of odor are subjective evaluations, and consequently are measured in terms of a subjective set of values, states the author. *Intensity* is the quantification of an odor according to the degree of detection. Accordingly, a descriptive set of values is established and correlated with a numerical scale which lends itself to statistical treatment. A scale of five values in common use is as follows:

No odor	0
Barely detectable odor	1
Definite odor	2
Strong odor	3
Overpowering odor	4

Mr. Nader defines the *quality* of an odor as an odor characteristic evaluated with descriptive words which associate it with familiar materials or with subjective reactions. Familiar materials introduce descriptive words, such as, fruity, flowery, and burnt. Words indicative of subjective reaction include fragrant, sweet, foul, and nauseating. Often more than one reference scale is used to classify an odor according to quality. An example of this is the Crocker-Henderson system, which utilizes four reference qualities (fragrant, acid, burnt, and caprylic) each on a nine-point intensity scale.

Acceptability is another odor characteristic which is rated on a subjective scale of values. These are referred to the degree of pleasantness of the odor, ranging from the very pleasant to the very unpleasant.

The fourth characteristic of odor, according to the author, is variously referred to as *pervasiveness, odor potential,* or *threshold dilution ratio.* These essentially are a measure of the ability of an odor to pervade a larger volume of dilution air and continue to possess a detectable intensity. The *odor unit,* defined as the amount of odor in a cubic foot of air at threshold intensity, is a unit of measure of odor potential. A practical measure giving information on odor potential is the threshold dilution ratio, which is the ratio of odorant concentration to its threshold concentration. A ratio of 100:1, for example, would indicate an odor potential of 100 units. This in effect means that the odorant present in a cubic foot of air is capable of odorizing 100 cu ft of clean air to the threshold level.

Perceptual data from tests on one individual are of limited value because of the wide range of response between individuals. The preferred procedure is to use a number of persons as a test panel so as to provide statistical data that will properly define the range of response.

Mr. Nader, who is Chief, Instrumentation Unit, Community Air Pollution Program, Robert A. Taft Sanitary Engineering Center, U. S. Public Health Service, Cincinnati, Ohio, presented his paper to the 22nd Annual Meeting of the Industrial Hygiene Foundation, Pittsburgh, Pa.

THE DISCOMFORT INDEX

During the spring of 1959 the U. S. Weather Bureau announced that it would make public values of the Discomfort Index for certain cities. This useful Index is the subject of this and two subsequent Reference Data sheets.

During the nineteen-twenties the American Society of Heating and Ventilating Engineers developed its Effective Temperature scale. By extensive laboratory tests "effective temperature values" were established for each group of separate simultaneous dry bulb temperature and relative humidity (or wet bulb temperature) readings which gave *equivalent feelings of comfort.*

Although Effective Temperature has been widely used by heating and air conditioning engineers, it was not widely known by non-engineers. More recently, J. F. Bosen of the Office of Climatology of the Weather Bureau reduced Effective Temperature to a formula:

$$DI = 0.4\ (t_d + t_w) + 15 \qquad (1)$$

where DI = the Discomfort Index,
t_d = dry bulb temperature,
t_w = wet bulb temperature.

For example, if the dry bulb temperature is 92 deg and the wet bulb temperature is 80 deg, the Discomfort Index is

$$DI = 0.4\ (92 + 80) + 15 = 83.8$$

The value and the usefulness of the Discomfort Index is due to its direct relationship with the degree of discomfort experienced. It is known that a few people in summer will be uncomfortable from heat and humidity by the time the Discomfort Index reaches 70; half or more of the people will be uncomfortable by the time the Discomfort Index reaches 75; everyone will be looking for relief by the time the Discomfort Index reaches 79, and discomfort will become more acute as the Index climbs still higher. Infrequently, Discomfort Index values reach 90, and 92 is the highest noted so far in the sampling of United States data.

The efficiency of workers decreases noticeably with higher Discomfort Index values. This is recognized in the Washington, D. C., area, for example, where government workers in non-air-conditioned buildings may be dismissed when conditions are such that the Discomfort Index exceeds 85.

Many names and ideas have been proposed during recent years with the view of developing a more meaningful term than Effective Temperature. The term, Discomfort Index, has been well received, perhaps because people are more concerned as their discomfort increases.

Weather Bureau data are more frequently made available in terms of relative humidity rather than wet bulb temperature. Consequently, for these cases, equation (2) can be used where the dry bulb temperature and relative humidity are known:

$$DI = t_d - (0.55 - 0.55RH)(t_d - 58) \qquad (2)$$

where RH is relative humidity, expressed as a decimal.

For example, if the dry bulb temperature is 92 deg and the relative humidity 57%, the Discomfort Index would be:

$$\begin{aligned} DI &= 92 - (0.55 - 0.55 \times 0.57)\ (92 - 58) \\ &= 92 - (0.2365)\ (34) \\ &= 92 - 8.04 = 84.0 \end{aligned}$$

Occasionally data are available in dew point temperature rather than either relative humidity or wet bulb temperature. In this case, the formula is:

$$DI = .55\ t_a + .2t_{dp} + 17.5$$

where t_{dp} is the dew point temperature

For example, if the dry bulb temperature is 92 deg and the dew point temperature is 76 deg:

$$\begin{aligned} DI &= .55\ (92) + .2\ (76) + 17.5 \qquad (3) \\ &= 50.6 + 15.2 + 17.5 = 83.3 \end{aligned}$$

The most common case, however, is that to which equation (2) applies—that where relative humidity and dry bulb temperature are known. For this case, the accompanying table has been tabulated.

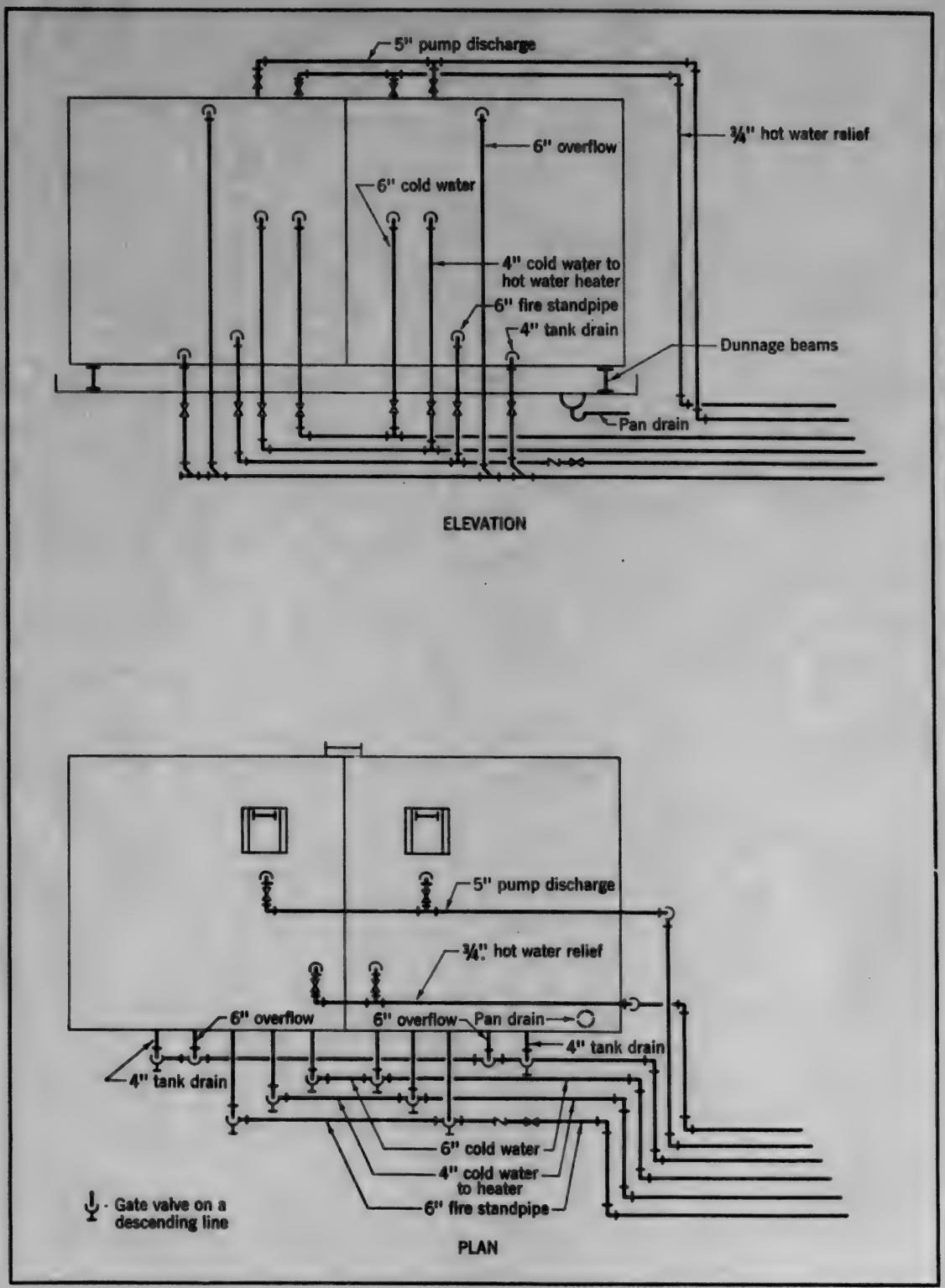
To find the Discomfort Index for the same conditions as that given in the illustrative example following equation (2); namely, for a dry bulb temperature of 92 deg and relative humidity of 57%, enter the table at 92 deg in the extreme left column of the table, proceeding to the extreme right, under the column headed 57, to find DI = 84.0.

The table will continue on next month's Reference Data pages.

Dry Bulb Temperature, Deg F	Relative Humidity, Per Cent															
	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57
	Discomfort Index															
70	66.2	66.2	66.3	66.4	66.4	66.5	66.6	66.6	66.7	66.8	66.8	66.9	67.0	67.0	67.1	67.2
71	66.9	66.9	67.0	67.1	67.1	67.2	67.3	67.4	67.4	67.5	67.6	67.6	67.7	67.8	67.9	67.9
72	67.5	67.6	67.7	67.8	67.8	67.9	68.0	68.1	68.2	68.2	68.3	68.4	68.5	68.5	68.6	68.7
73	68.2	68.3	68.4	68.5	68.5	68.6	68.7	68.8	68.9	69.0	69.0	69.1	69.2	69.3	69.4	69.5
74	68.9	69.0	69.1	69.2	69.3	69.3	69.4	69.5	69.6	69.7	69.8	69.9	70.0	70.0	70.1	70.2
75	69.6	69.7	69.8	69.9	70.0	70.0	70.1	70.2	70.3	70.4	70.5	70.6	70.7	70.8	70.9	71.0
76	70.3	70.4	70.5	70.6	70.7	70.8	70.9	71.0	71.1	71.2	71.3	71.4	71.5	71.5	71.6	71.7
77	70.9	71.0	71.2	71.3	71.4	71.5	71.6	71.7	71.8	71.9	72.0	72.1	72.2	72.3	72.4	72.5
78	71.6	71.7	71.8	72.0	72.1	72.2	72.3	72.4	72.5	72.6	72.7	72.8	72.9	73.1	73.2	73.3
79	72.3	72.4	72.5	72.7	72.8	72.9	73.0	73.1	73.2	73.3	73.5	73.6	73.7	73.8	73.9	74.0
80	73.0	73.1	73.2	73.3	73.5	73.6	73.7	73.8	74.0	74.1	74.2	74.3	74.4	74.6	74.7	74.8
81	73.7	73.8	73.9	74.0	74.2	74.3	74.4	74.6	74.7	74.8	74.9	75.1	75.2	75.3	75.4	75.6
82	74.3	74.5	74.6	74.7	74.9	75.0	75.1	75.3	75.4	75.5	75.7	75.8	75.9	76.1	76.2	76.3
83	75.0	75.1	75.3	75.4	75.6	75.7	75.9	76.0	76.1	76.3	76.4	76.5	76.7	76.8	77.0	77.1
84	75.7	75.9	76.0	76.1	76.3	76.4	76.6	76.7	76.9	77.0	77.1	77.3	77.4	77.6	77.7	77.9
85	76.4	76.5	76.7	76.8	77.0	77.1	77.3	77.4	77.6	77.7	77.9	78.0	78.2	78.3	78.5	78.6
86	77.1	77.2	77.4	77.5	77.7	77.8	78.0	78.2	78.3	78.5	78.6	78.8	78.9	79.1	79.2	79.4
87	77.8	77.9	78.1	78.2	78.4	78.6	78.7	78.9	79.0	79.2	79.3	79.5	79.7	79.8	80.0	80.1
88	78.4	78.6	78.8	78.9	79.1	79.3	79.4	79.6	79.8	79.9	80.1	80.2	80.4	80.6	80.7	80.9
89	79.1	79.3	79.5	79.6	79.8	80.0	80.1	80.3	80.5	80.7	80.8	81.0	81.2	81.3	81.5	81.7
90	79.8	80.0	80.1	80.3	80.5	80.7	80.9	81.0	81.2	81.4	81.6	81.7	81.9	82.1	82.3	82.4
91	80.5	80.7	80.8	81.0	81.2	81.4	81.6	81.7	81.9	82.1	82.3	82.5	82.7	82.8	83.0	83.2
92	81.2	81.3	81.5	81.7	81.9	82.1	82.3	82.5	82.7	82.8	83.0	83.2	83.4	83.6	83.8	84.0
93	81.8	82.0	82.2	82.4	82.6	82.8	83.0	83.2	83.4	83.6	83.8	84.0	84.1	84.3	84.5	84.7
94	82.5	82.7	82.9	83.1	83.3	83.5	83.6	83.9	84.1	84.3	84.5	84.7	84.9	85.1	85.3	85.5
95	83.2	83.4	83.6	83.8	84.0	84.2	84.4	84.6	84.8	85.0	85.2	85.4	85.6	85.8	86.1	86.3
96	83.9	84.1	84.3	84.5	84.7	84.9	85.1	85.3	85.6	85.8	86.0	86.2	86.4	86.6	86.8	87.0
97	84.6	84.8	85.0	85.2	85.4	85.6	85.9	86.1	86.3	86.5	86.7	86.9	87.1	87.4	87.6	87.8
98	85.2	85.5	85.7	85.9	86.1	86.3	86.6	86.8	87.0	87.2	87.4	87.7	87.9	88.1	88.3	88.5
99	85.9	86.2	86.4	86.6	86.8	87.1	87.3	87.5	87.7	88.0	88.2	88.4	88.6	88.9	89.1	89.3
100	86.6	86.8	87.1	87.3	87.5	87.8	88.0	88.2	88.5	88.7	88.9	89.1	89.4	89.6	89.8	90.1
102	88.0	88.2	88.5	88.7	88.9	89.2	89.4	89.7	89.9	90.1	90.4	90.6	90.9	91.1	91.4	91.6
104	89.3	89.6	89.8	90.1	90.3	90.6	90.8	91.1	91.4	91.6	91.9	92.1	92.4	92.6	92.9	93.1
106	90.7	91.0	91.2	91.5	91.7	92.0	92.3	92.5	92.8	93.1	93.3	93.6	93.9	94.1	94.4	94.7
108	92.1	92.3	92.6	92.9	93.2	93.4	93.7	94.0	94.3	94.5	94.8	95.1	95.4	95.6	95.9	96.2
110	93.4	93.7	94.0	94.3	94.5	94.8	95.1	95.4	95.7	96.0	96.3	96.6	96.8	97.1	97.4	97.7
112	94.8	95.1	95.4	95.7	96.0	96.3	96.6	96.9	97.2	97.5	97.7	98.0	98.3	98.6	98.9	99.2
114	96.1	96.4	96.8	97.1	97.4	97.7	98.0	98.3	98.6	98.9	99.2	99.5	99.8	100.1	—	—
116	97.5	97.8	98.1	98.5	98.8	99.1	99.4	99.7	100.1	—	—	—	—	—	—	—
118	98.9	99.2	99.5	99.9	100.2	—	—	—	—	—	—	—	—	—	—	—
120	100.2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

HOT WATER HEATER HOOKUPS

HOUSE TANK CONNECTIONS

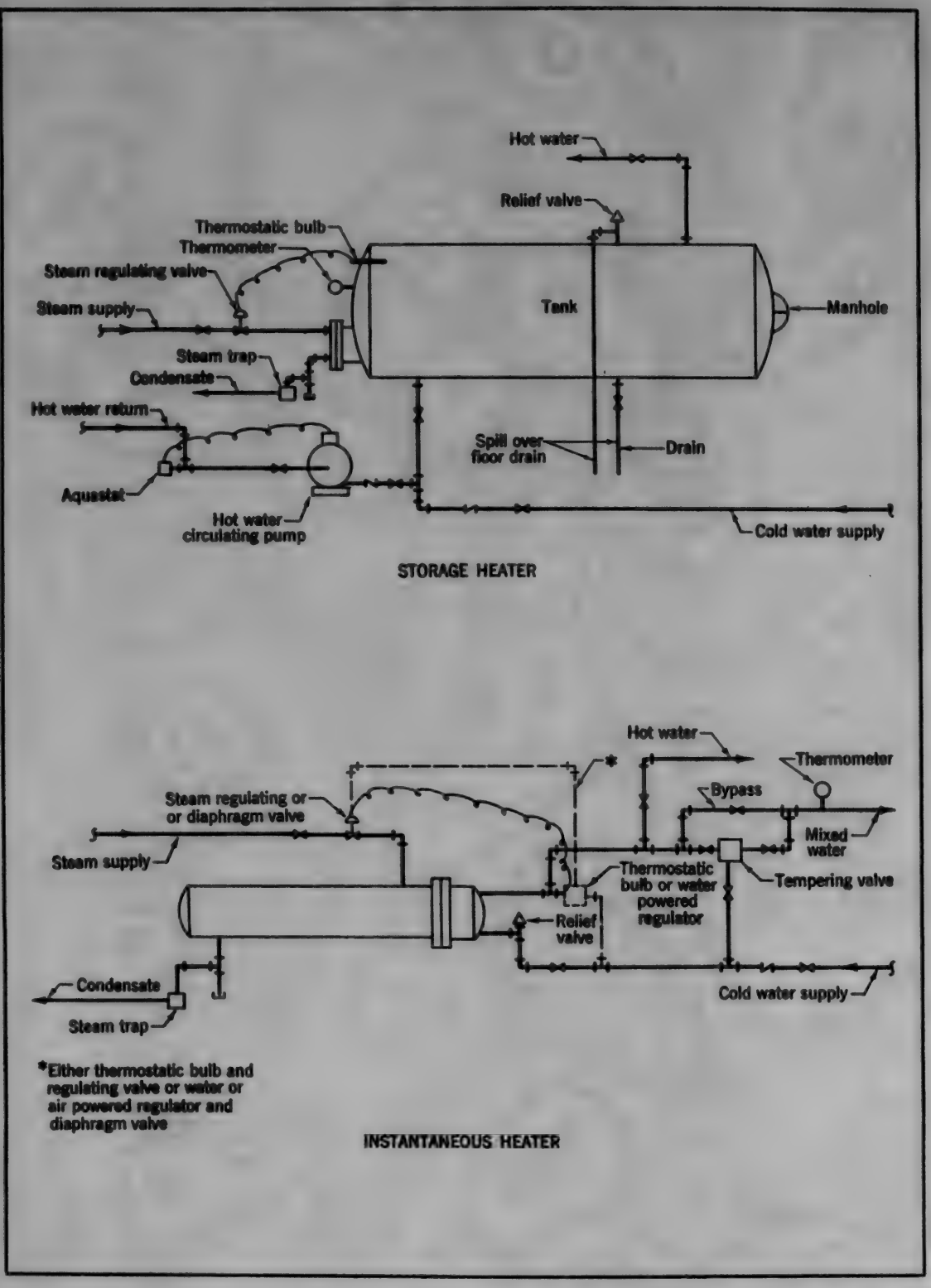


DETAIL SHEET—AIR CONDITIONING, HEATING AND VENTILATING

June, 1959

Sizing of Steam Heating Equipment

HOT WATER HEATER HOOKUPS



DETAIL SHEET—AIR CONDITIONING, HEATING AND VENTILATING

June, 1959

LOUIS BLENDERMANN ON

Sizing of Steam Heating Equipment Needs Further Study

Lewis Smith
Heating Engineer, New York, N. Y.

The author discusses the advantages of re-evaluating some well-established engineering principles. One example is the operation of steam heating systems at higher pressures for resulting economies in space and installed costs.

THE principles involved in the design of steam heating systems have been so well established for so many years and widely accepted that it is difficult to criticize them. Yet this has recently been done in the matter of pipe sizing.† If such modifications on fundamental concepts lead to a reduction of the installed cost without impairing efficiency, they should be most carefully weighed, for certainly nothing is more welcome in these days of rising costs than spending less money for the same result.

Pipe sizing is not the only matter open to criticism. What about the sizing of radiators and convectors? For many years these have been tested and rated on the basis of steam at approximately 1 lb-gage pressure (215 degrees), although on practically any steam heating job the boiler pressure can be raised to 5 lb-pressure in the radiators, and sometimes even more. This increases the heat emission of the radiators by about 12%, so that if the system were designed for the higher pressure, less radiator or convector capacity would be needed. This would lower the radiator cost, but not in proportion, since the number of radiators or cabinets would not be reduced, but it would enable the designer to use less space and perhaps, for example, permit use of a 4-inch rather than a 6-inch wide cabinet.

If some form of temperature control is used, good control is just that much easier to achieve if the size of the radiators has been cut 12% to start with.

It may be argued in rebuttal "Sure, I know that raising the pressure will result in more capacity but I'm relying on that to take care of those days when the outside temperature is below my design base, and for rapid pick-up, especially after a week end shut down."

Just how valid is this argument?

If the outside temperature does go below the design temperature, it is likely to be for such a short time that almost any building would have enough stored heat to carry over this short period with little inside temperature drop. An examination of the New York City weather reports, for example, where zero to 70 deg F is usually taken as the design temperature range, shows that zero was recorded only once in the last 10 years and then only for 1½ hours (Feb. 3, 1955). Further, while the wind had been fairly strong when the temperature was dropping, the wind velocity had declined to the normal figure of 15 miles per hour at the time of zero temperature, 15 mph being the velocity used for calculating the coefficients of heat transfer for building materials. It is true that zero and below was reached a number of times in the previous 76 years and that on one day, Feb. 9, 1934, the temperature reached —14 and stayed below zero for 15 consecutive hours; however, that was a once-in-a-lifetime-event and would hardly be justification for designing to —14 deg. All in all, then, it hardly seems necessary to provide for a safety factor on this account.

It may also be argued that steam is hot enough at 1 lb pressure to cause objectionable odors if continued too long, so that increasing the pressure appears to be a step in the wrong direction. What is overlooked here is that this pressure is so rarely needed that, if there is an operator on duty, he can adjust the pressure controls for those few occasions by hand. Or this can easily be done automatically by means of an outdoor thermostat which, at say 10 deg above zero (where zero to 70 deg is the design range) will cut in a second pressure limit switch set for the higher pressure.

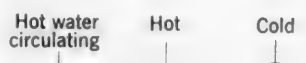
As to rapid heating up, no longer time would be required with steam at 5 lb pressure in 12% less radiator capacity than for 1 lb on the standard basis. There is nothing to be concerned about until the outdoor temperature gets close to the outside design temperature and then it is customary and in most cases necessary to keep the heat on all night to protect the plumbing and sprinkler system. This applies equally well to week-end shutdowns, as in schools, where in northern climates it is the rule to keep some heat on during week-ends in cold weather.

The writer has had considerable experience with subatmospheric steam systems where vacuum is used to control temperatures and has often asked operators if they ever saw pressure in the system and the answer has almost always been No. This indicates clearly that the majority of jobs may have too much capacity, because most designers like to be liberal in their calculations for safety's sake.

Turning to pumps, condensate or vacuum, we find an anomalous situation where no one seems to agree. Years ago an agreement was reached to size pumps so that they would be capable of removing water from the system at three times the normal condensation rate, so as to take care of excess condensate when starting up the heating

(Concluded on page 154)

† New Piping Economies for Steam Heating Systems, Wright and Beckwith, Air Conditioning, Heating and Ventilating, January, 1959.



The engineer must decide whether he wants the several piping mains installed with the centerline of the

Arrangement of Water Distribution Mains

ADEQUATE sizing of a water distribution system ensures that all the fixtures and equipment in a building will obtain a sufficient quantity of water at a prescribed pressure best suited for the function of the particular fixtures and equipment. Aside from the system being properly sized, it is important that the arrangement of the water distribution system is carefully planned and installed. This careful planning of a water distribution system means that the piping runs were plotted on the drawings so that straight mains with smooth flow turns, offsets and branch main connections result in smooth water flow. The piping layout should offer direct connections to the risers and yet avoid any piping traps and confusion that may result at branch connections. Troublesome conditions do develop when there is lack of adequate planning.

Typical Piping Arrangement

For an example of the factors that must be considered in a water distribution system, Fig. 1 is offered. This illustration represents an apartment house building of say 6 stories high. Each set of risers will serve the kitchens and bathrooms located one over the other on each floor level. Applications such as connections to heating equipment, laundry equipment, sillcocks or other appurtenances or equipment have not been shown for the sake of clarity.

The first step necessary before the water and branch mains can be plotted is to locate the desired position of the risers. The risers are planned with relation to the most favorable position of the cold, hot and hot water circulation lines with regard to the fixtures and equipment served. After this planning, only the small circles representing each riser will appear on the basement plan or drawing.

The next step is to lay out in a preliminary manner, the most suitable path for the water distribution mains to follow in supplying the risers. As this phase of design proceeds, all walls, partitions, columns and steel framework must be investigated to be certain of clear passage for the piping. Also it is required that some coordination with other trades be checked at this time. For example, where will lighting be located. Stay clear of electric equipment, conduits and switch boxes. Check with the heating engineer to learn of his proposed location of equipment, piping and ductwork. Spot your proposed locations of fire standpipe piping and the gas piping, if it is used.

Since the design of the water distribution system and other trades are only preliminary at this time and are subject to later refinement, it is still possible to determine the desired piping run. The final design and all the critical areas can be checked more thoroughly later as the other trades finalize their design effort.

Thus we have now established our basic piping runs. The next step requires that the branch mains be taken from the mains in such a manner that they will be direct and not trapped anywhere in the system. Branch mains are usually connected to the top of the mains by means of either 45 deg elbows or vertical nipples and tees. Spacing of the mains is rather important because pipe covering must be taken into consideration and sufficient room must be provided for the various piping connections that must be made. In addition, sufficient space

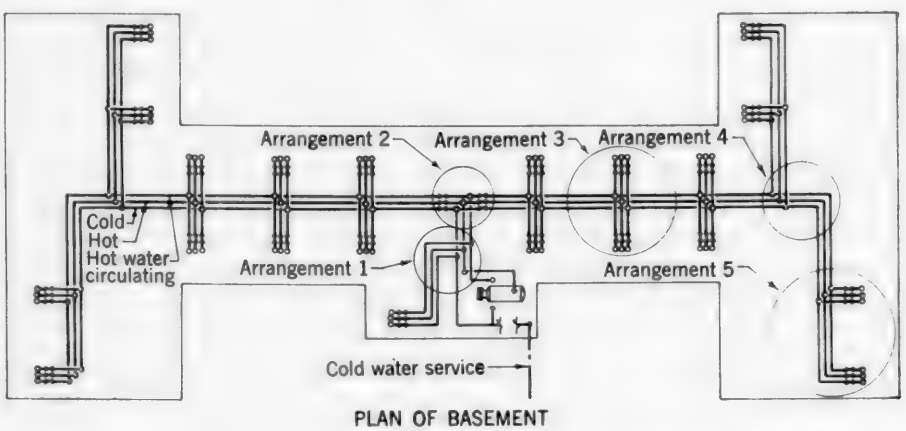


Fig. 1. An arrangement of water mains and branch mains in the basement of an apartment house. Circles indicate areas that are shown in greater detail in other figures.

ally fitted into the underside of the pipe covering to permit the pipe to rest on its support without crushing the covering.

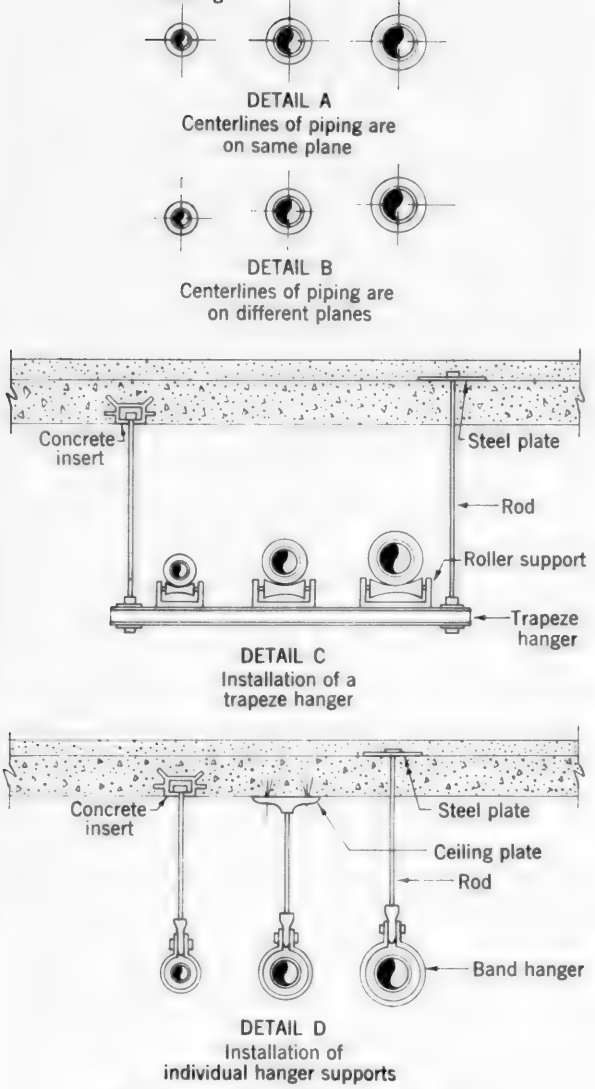


Fig. 2. Methods of supporting pipe.

is needed to swing the valves in place, even considering, that the valve stem can be removed while the valve body is installed.

After the arrangement of the water distribution mains and branch mains have been finalized with regard to the structure it must then be finalized with all the other trades to ensure that adequate clearance is provided for the systems. Where critical areas exist, exact elevations of piping must be established to be sure of positive clearance between other piping, ductwork or electrical conduits. Now we are ready to give some attention to other factors that produce a well designed system. Incidentally, expansion joints, unions and other devices normally used with the piping system have been disregarded in Fig. 1, to simplify the drawing of the piping system.

Supporting Devices

There are various devices available for supporting pipe. Figure 2 shows several types of hanger supports. Detail *A*, Fig. 2, or whether the piping will be installed with the bottom of the piping level as shown in Detail *B*. One method has no particular advantage over the other but one must be selected to provide the correct means of support.

Many engineers prefer to install their piping on trapeze hangers of the type indicated in Detail *C*. In this case the piping is arranged with the bottom of the piping level. However, the trapeze hanger is equally suitable for piping that is arranged as shown in Detail *A*. A trapeze hanger consists of two channels that are bolted together, back to back. Rods are secured to the ends of the hanger and extends up to the slab for attachment. The attachment means usually consists of either a concrete insert or a steel plate that is set on the rough slab and concealed by the finished floor. Often, a continuous strip insert is set in the underside of the slab to offer flexibility in the positioning of the rods to satisfy the placement of the piping.

The piping itself rests on roller supports which permit movement of the piping as caused by expansion or pressure surges. Other methods favored by the engineer may be used with equal success.

Detail *D*, shows the type supports that may be employed in the individual support of the piping. In this instance, band hangers are used and extend up to either a concrete insert, ceiling plate or steel plate. Many other devices are available for holding the pipe and securing the rods to the concrete slab construction or to the steel framework that may be erected.

It might be mentioned here that a special plate is usu-

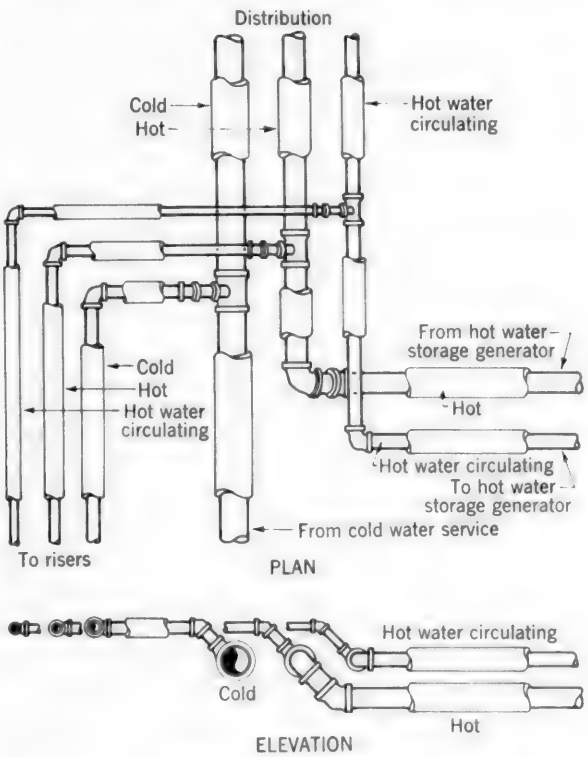


Fig. 3. Arrangement 1.

also serve to balance the hot and hot water circulation water flow. All valves installed at the base of risers and at the various sections of the piping, serve to help

Arrangement 1

Figure 3 which shows the runs of the cold, hot and hot water circulation mains, is a larger scale drawing of the pipe arrangement in Fig. 1. The hot water main from the hot water storage generator rises at a 45 deg offset to tie in with the hot water main. The mains in this detail is illustrated with the centerlines of the piping on the same plane. All piping arrangements shown hereafter in this article are shown in the same manner. However, the piping is shown this way for example only; it can also be arranged as shown in Detail *B* of Fig. 2, with pipe center lines on different planes.

Branch mains are taken from the mains at a 45 deg offset to provide a smooth water flow.

Although threaded fittings are used in all the arrangements illustrated, it is for the purpose of example only. Threaded, soldered or flanged fittings can also be used, depending on the particular piping materials that the engineer selects. In this case, Type *B* copper tubing is shown and the fittings represent either threaded or silver soldered fittings. For this type of piping material, care must be used in properly spacing the piping supports. The same consideration applies to all types of piping material for adequate support must be provided where required.

Arrangement 2

Figure 4 illustrates an enlarged arrangement of the piping also illustrated in Fig. 1.

Here the mains divide into sub-mains to supply each half of the building. The sub-mains are at a higher elevation than the mains and the connections are made with 45 deg offsets as shown. Valves control each section of the piping to permit flexibility for repair and adjustment of piping or controls in either section. Valves are shown in an upright position, but, here again, the engineer may indicate the placement of valves in any particular position he favors.

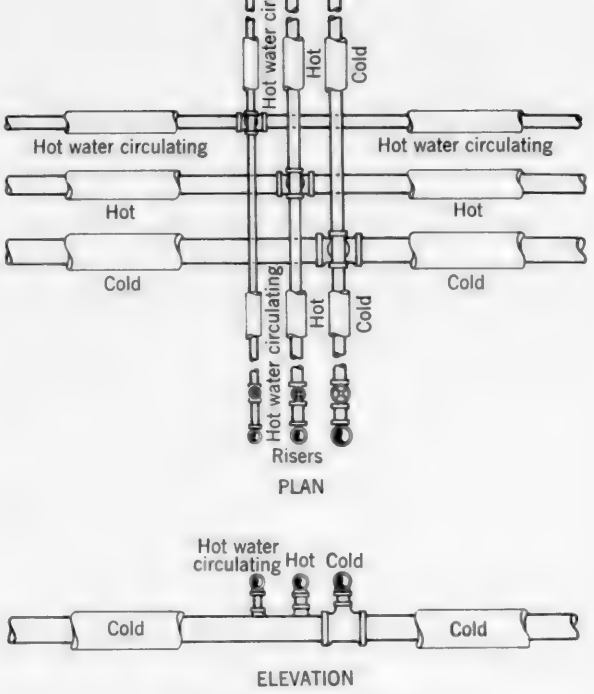


Fig. 5. Arrangement 3.

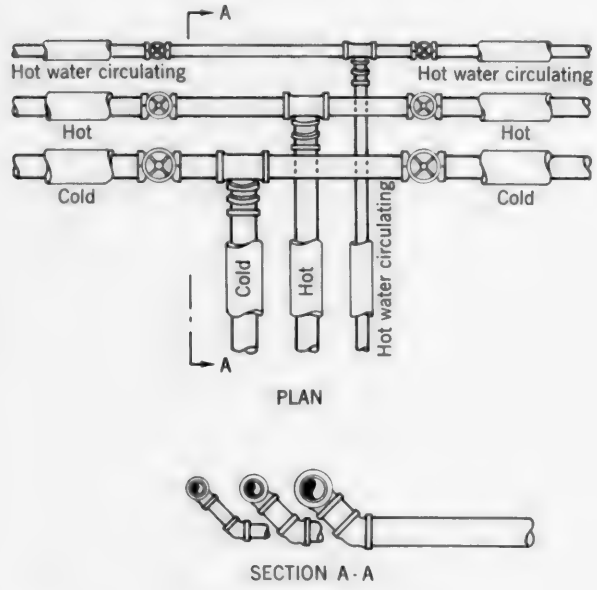


Fig. 4. Arrangement 2.

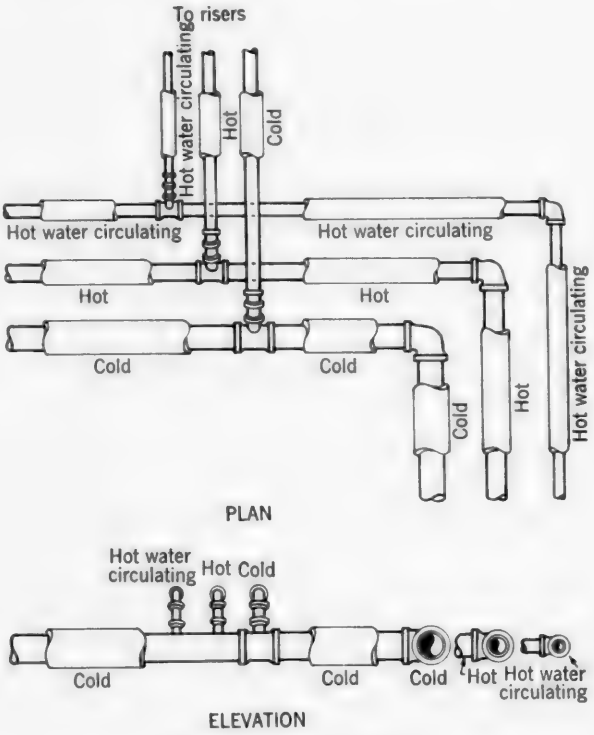


Fig. 6. Arrangement 4.

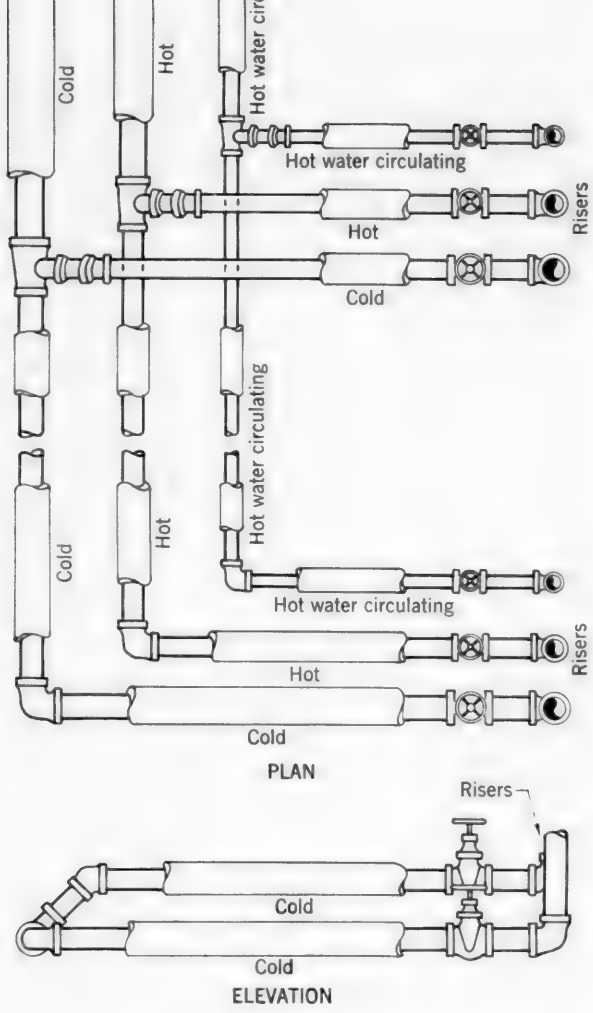


Fig. 7. Arrangement 5.

Arrangement 3

Arrangement 3, illustrated in Fig. 5, shows a double take-off of branch mains which will serve the risers at each side of the building and correspond to the arrangement denoted in Fig. 1.

Nipples and tees are used to make the piping connections. Branch mains extend over to the base of the risers and are equipped with control valves. The control valves balance the circulation of hot water to the various fixtures in the building. It is through the various valves that the proper balance of hot water circulation can be attained; this avoids the possibility that any section of the piping system may be by-passed with regard to its share of hot water. Unions and drain valves have not been included in these enlarged arrangements but may be incorporated in the specific manner favored by the engineer. Balancing valves are important and should not be overlooked in the design, since they are the only means of regulating the desired water flow.

Arrangement 4

In Fig. 6 is shown Arrangement 4. Here a 90 deg offset is shown for piping sub-mains. The same spacing should be utilized for the piping throughout to be sure that there is sufficient room between the piping and that there is not occasion for one pipe to touch another. The branch mains are taken off at a 45 deg offset to provide a smooth water flow. There should be sufficient space between the branch mains. All of the conditions shown in this half of the building are equal to the piping arrangement in the other half of the building with the exception perhaps that some of the branch main connections may be slightly different to satisfy requirements for the risers.

Arrangement 5

Figure 7 shows the final arrangement (No. 5) of piping. Here the sub-mains terminate at one set of the risers as shown. The branch mains are connected to the mains by means of 45 deg connections. Valves are provided at the base of the risers for the control and balance of water flow. Pipe covering has been included on all the piping. For the hot and circulating piping, the covering serves as insulation to retain the water temperature. For the cold water piping the covering serves as anti-sweat protection.

It is always an easy matter to sketch a water distribution system on a set of drawings and leave the final arrangement of the piping up to the contractor. This practice does not reflect design ability nor does it explore all the possibilities that must be checked in order to provide a system of piping that clears the structure and the equipment and piping of other trades. A well thought out arrangement of piping is as important as an adequately sized piping system.

Six Tips for Car Comfort

Six ways that car owners can get the most for their air conditioning dollar were suggested by J. D. Loveley, Chrysler Corporation's assistant chief engineer for vehicle air conditioning, at The University of Michigan's sixth annual Institute for Teachers of Auto Mechanics.

In brief, he advised: Buy heat-absorbing glass. Get a light-colored model. Use low gears in city traffic. Turn directional grilles toward your face to get maximum initial cooling. Use completely recirculated air to bring the temperature down in a hurry. And, park in the shade wherever it is possible for the driver to do so.

Mr. Loveley explained that heat-absorbing glass cuts transmission of heat by 40% to 70%, compared to clear glass. Light-color paint slows down, but does not stop, initial heat build-up in parked cars. Driving in low or intermediate gear boosts air conditioning compressor capacity by as much as 50%.

After the car is cooled, drivers should avoid direct exposure to cool air by turning the grille vents, and should use fresh instead of recirculated air, he added.

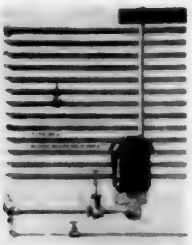
NEW LITERATURE

Use the prepaid postcard on last page for securing your copies of these catalogs.

Liquid Level and Flow Control

Information telling how to apply the company's operating and safety controls to a wide variety of jobs involving liquid level and liquid flow is contained in 24-page Bulletin ERS-A, published and offered by McDonnell & Miller, Inc., Chicago, Ill. Schematic diagrams are included.

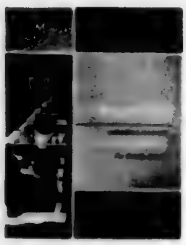
Circle **Item 1** on Inquiry Card



Small Pumping Unit

A catalog describing small centrifugal pumps for air conditioning systems, lawn sprinkling systems, small cooling tower systems, and other package equipment, is available from Pump Div., C. H. Wheeler Mfg. Co., Philadelphia, Pa. It contains outline dimensions and design data.

Circle **Item 2** on Inquiry Card



Asbestos-Cement Sewer Pipe

Brochure TR-206A, from Johns-Manville, New York, N. Y., shows how Transite asbestos-cement sewer pipe helps produce "a bigger day's work for a bigger day's income." Drawings point up such advantages as easier handling in the trench, easier laying to line and grade.

Circle **Item 3** on Inquiry Card

Volume Water Heaters

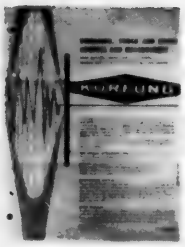
A bulletin describing its WH Series tankless, twin-coil volume water heater is available from Portmar Water Heater Co., Brooklyn, N. Y. Bulletin provides capacity and dimension charts for 14 sizes of gas and oil-fired, large-volume instantaneous heaters. Piping diagrams included.

Circle **Item 4** on Inquiry Card

Dust and Fume Control

Sixty plant installations of dust and fume control systems, in a variety of major industries, are described in a 52-page catalog published by The Kirk & Blum Manufacturing Co., Cincinnati, Ohio. Includes systems in ceramic, foundry, metalworking, woodworking industries.

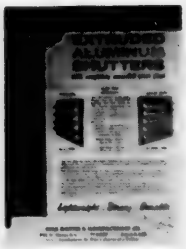
Circle **Item 5** on Inquiry Card



Vibration and Noise Control

Eight-page booklet, K4E, from The Korfund Co., Inc., Long Island City, N. Y., gives engineering specifications and performance data for 27 types of products for control and measurement of vibration, shock, and noise. Installation photos show how typical problems were solved.

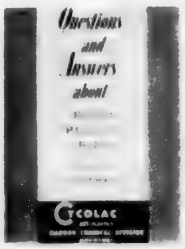
Circle **Item 6** on Inquiry Card



Extruded Aluminum Shutters

Extruded aluminum shutters and dampers manufactured by Elgo Shutter & Manufacturing Co., Detroit, Mich., are described in 4-page Catalog No. 1160. It includes types for vertical and horizontal mounting for exhaust purposes, plus types designed for installing inside duct work.

Circle **Item 7** on Inquiry Card



Rigid Plastic Pipe

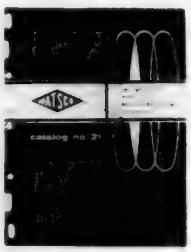
Questions and answers about rigid plastic pipe made of ABS plastics are contained in a folder issued by Marbon Chemical Div., Borg-Warner Corp., Washington, W. Va. Written to provide basic performance and installation facts, folder lists benefits offered by ABS pipe.

Circle **Item 8** on Inquiry Card

Packaged Liquid Chillers

Packaged liquid chillers manufactured by Frick Company, Waynesboro, Pa., are described in 4-page Bulletin No. 802-A. Specifications are detailed. Table contains capacities and principal dimensions of the packaged units which range from 20 through 180 nominal tons of refrigeration.

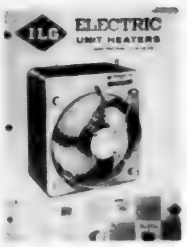
Circle **Item 9** on Inquiry Card



Air Conditioning Products

Refrigeration and air conditioning products, from Watsco, Inc., Hialeah, Fla., are described in the firm's 1959 edition of Catalog No. 21. The catalog is seen to be of interest to original equipment manufacturers, as well as to servicemen and wholesalers. Many new items are included.

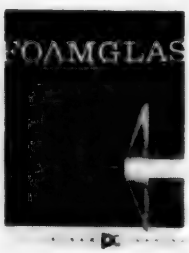
Circle **Item 10** on Inquiry Card



Electric Unit Heaters

Complete specifications and construction information on the company's line of electric unit heaters are given in Bulletin No. 808, published by Ilg Electric Ventilating Co., Chicago, Ill. The four-page bulletin covers units with capacities ranging from 1½ to 36 kilowatts.

Circle **Item 11** on Inquiry Card



Building Insulation

A 20-page catalog on the use of Foamglas insulation in the building field is published by Pittsburgh Corning Corp., Pittsburgh, Pa. Catalog contains information on uses of the cellular glass insulation, in addition to drawings and specifications for typical applications.

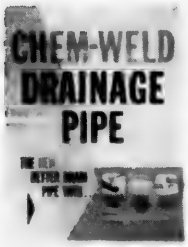
Circle **Item 12** on Inquiry Card

Use the prepaid postcard on last page for securing your copies of these catalogs.

Compact Water-Tube Boilers

A 16-page bulletin, No. 491, issued by Vapor Heating Corp., Chicago, Ill., describes recent industrial installations of the company's Drum Modulatic water-tube boiler. Photos show how heating problems were solved by single and multiple boilers, low and high pressure systems.

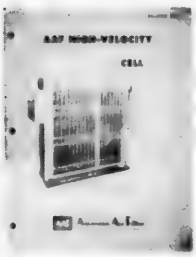
Circle **Item 13** on Inquiry Card



Plastic Drainage Pipe

Southwestern Plastic Pipe Co., Mineral Wells, Tex., offers a 4-page bulletin describing its line of Chem-Weld drainage pipe and fittings. Bulletin outlines advantages, installation, and handling of this pipe, and shows how it may be easily connected to other types of pipe.

Circle **Item 14** on Inquiry Card



Electronic Air Cleaner

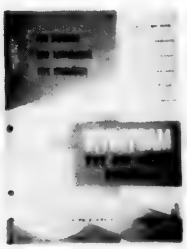
American Air Filter Co., Inc., Louisville, Ky., has published a bulletin describing its new line of high-velocity Electro-Cell electronic air cleaners. Bulletin No. 258A explains electronic principle of operation, describes collector cell construction, gives details on basic design features.

Circle **Item 15** on Inquiry Card

General Purpose Valves

Kerotest Manufacturing Co., Pittsburgh, Pa., offers Bulletin KS-1-N, a 4-page brochure covering the company's line of small valves for general application. Information pertaining to working pressures, specifications, construction features, and suggested applications has been included.

Circle **Item 16** on Inquiry Card



Pipe and Vessel Covering

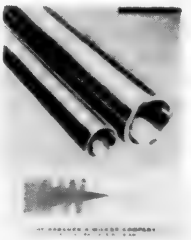
A 12-page bulletin, No. 157-57, on Styrofoam pipe and vessel covering for low temperature insulation is published by The Dow Chemical Co., Midland, Mich. Brochure presents engineering data, recommended application techniques, and charts on recommended thicknesses and heat gain.

Circle **Item 17** on Inquiry Card

Plan Filing Equipment

Plan Hold Corp., South Gate, Calif., manufacturer of vertical and roll filing systems, announces its 12-page catalog for 1959. New and improved plan filing equipment is included, and seen to be of special interest to engineers, designers and architects. All products are illustrated.

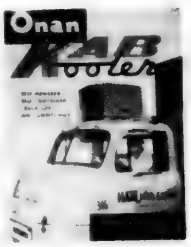
Circle **Item 18** on Inquiry Card



Pipe Dimensions

Pipe specifiers are offered a new technical data bulletin published by Tubular Products Div., The Babcock & Wilcox Co., Beaver Falls, Pa. Bulletin TDC-191 contains the dimensions and weights per foot of pipe in sizes from ⅛ through 36 inches for all schedules.

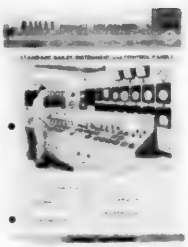
Circle **Item 19** on Inquiry Card



Truck Cab Air Conditioner

How the Kab Kooler, a self-powered, self-contained truck cab air conditioner, makes the driver's cab the "most comfortable spot on the road" is told in a 4-page folder, F-107, published by D. W. Onan & Sons Inc., Minneapolis, Minn. Installation and servicing are described.

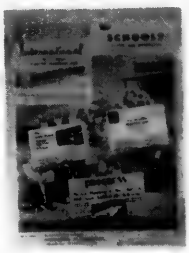
Circle **Item 20** on Inquiry Card



Instrument and Control Panels

Details of construction, dimensions, weights, instrument mounting, and accessories for six standard styles of instrument and control panels are contained in sixteen-page Product Specification G71-7, published by Bailey Meter Co., Cleveland, Ohio. Tubing, wiring procedures included.

Circle **Item 21** on Inquiry Card



Electrical Heating of Schools

A 4-page booklet on the electrical heating of schools is published by Electric Heating Div., International Oil Burner Co., St. Louis, Mo. Booklet shows how company's hot water electric baseboard system provides advantages of hot water heat with low operating cost.

Circle **Item 22** on Inquiry Card

Fan and Limit Controls

A new booklet covering fan and limit controls produced by White-Rodgers Co., St. Louis, Mo., is offered by the firm. Features, action, operation and mounting of each control series are explained; also, how and where to use the individual controls. Specifications are listed.

Circle **Item 23** on Inquiry Card

Radiant Heating and Cooling

The story of the Airtex radiant-acoustical ceiling system is published in a 12-page booklet offered by Airtex Corp., Chicago, Ill. Booklet starts with a short history of radiant heat, and discusses its early use. Then it tells how the manufacturer's system provides comfortable heating, cooling.

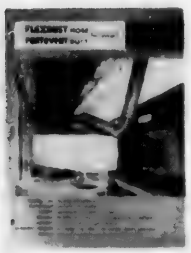
Circle **Item 24** on Inquiry Card

Use the prepaid postcard on last page for securing your copies of these catalogs.

Insulating Materials, Techniques

The ability of new insulating materials and techniques to cut home construction costs is covered in a bulletin entitled New Directions in Sidewall Insulation. Bulletin is available from Reflectal Corporation, architectural subsidiary of Borg-Warner Corp., Chicago, Ill.

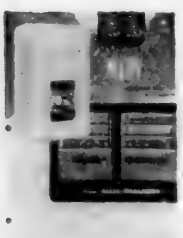
Circle **Item 25** on Inquiry Card



Air Handling

Uses of the company's Flexaust hose and Portovent duct in air handling applications are pictured and described in Bulletin 83, published by The Flexaust Co., New York, N. Y. In addition, material specifications and construction details are given, plus selection information.

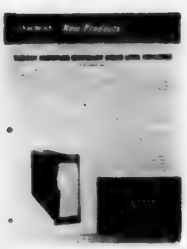
Circle **Item 26** on Inquiry Card



Motor Control Line

New low-voltage motor control line from Allis-Chalmers Mfg. Co., Milwaukee, Wis., is described in Bulletin 14B9182. Covering standard, special-design and accessory devices, 6-page booklet explains design features of basic starter, along with its various field modification kits.

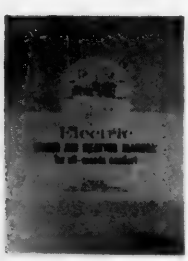
Circle **Item 27** on Inquiry Card



Secondary Liquid Level Indicator

Bulletin WG-1824, Supplement B, issued by Yarnall-Waring Co., Philadelphia, Pa., describes the company's new miniature transistorized secondary liquid level indicator. Bulletin describes where it is used, how it works, and gives construction details, advantages, and installation diagram.

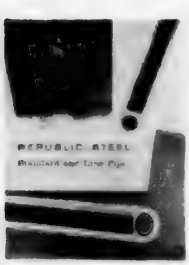
Circle **Item 28** on Inquiry Card



Electric Warm Air Heating

Announced by Heating and Air Conditioning Div., The Majestic Co., Inc., Huntington, Ind., is its 16-page Electric Warm Air Heating Manual. Designed to provide data on how to properly engineer and install an electric heating system, it includes a method of estimating annual kw-hrs.

Circle **Item 29** on Inquiry Card



Standard and Line Pipe

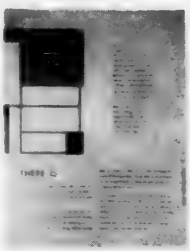
A 70-page catalog, Adv. 1015, from Republic Steel Corp., Cleveland, Ohio, gives technical information on the company's steel pipe, including line pipe, standard pipe, and water well pipe and casing. It contains a description of pipe making methods, plus comprehensive specification data.

Circle **Item 30** on Inquiry Card

Thermoplastic Drainage Fittings

UPVC (unplasticized polyvinyl chloride) drainage fittings, recommended for piping industrial, sanitary, and educational facility wastes, are described in a brochure available from Tube Turns Plastics, Inc., Louisville, Ky. Assembly of solvent cemented joints is illustrated.

Circle **Item 31** on Inquiry Card



Heat Transfer

The subject of heat transfer, by radiation, conduction, and convection, is discussed in bulletin published by Sellers Engineering Co., Chicago, Ill. Also covered are the problems involved in the transmission of heat from a hot gas through a metal surface into water.

Circle **Item 32** on Inquiry Card

Space Filter

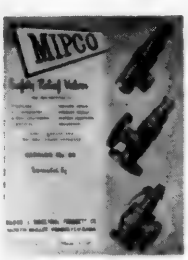
Performance, construction and installation details of the Dustfoe space filter are described in 8-page Bulletin No. 1505-6, available from Mine Safety Appliances Co., Pittsburgh, Pa. Filter is designed for economical and efficient air filtration in many industrial and commercial fields.

Circle **Item 33** on Inquiry Card

Controls and Motors

Controls and motors for every heating and air conditioning need are illustrated and described in a fold-out bulletin published by Controls Company of America, Milwaukee, Wis. Included are gas controls, oil controls, fan and blower controls, and fractional horsepower motors.

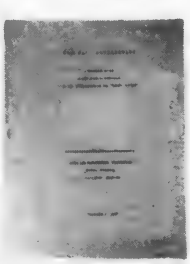
Circle **Item 34** on Inquiry Card



Safety Relief Valves

Comprehensive 84-page Catalog 88, issued by Marine & Industrial Products Co., North Wales, Pa., gives detailed information on the company's full line of safety relief valves for a wide range of power, processing, and general industrial services. Engineering section is included.

Circle **Item 35** on Inquiry Card



Gas Air Conditioning

A 38-page booklet, entitled Gas Air Conditioning, is offered by Arkla Air Conditioning Corp., Little Rock, Ark. It is called a detailed study of one program dedicated to the elimination of the "summer valley" in gas sales. A complete specification sheet and a price estimation form are included.

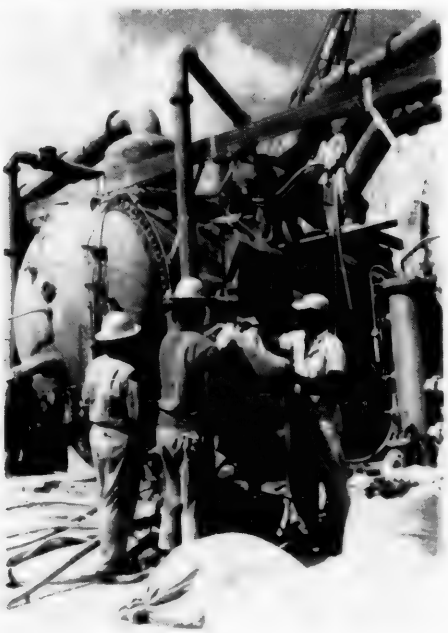
Circle **Item 36** on Inquiry Card

PRODUCT APPLICATIONS

New, Unusual, or Ingenious Uses of Equipment and Materials

Overseas Construction Time and Costs Cut By Novel Insulating Technique

It was desired to cut construction time during an unprecedented dry spell on Aruba so that this Caribbean island's 55,000 thirsty inhabitants could get drinking water ahead of schedule from their new $11,000,000 government-owned sea water distillation plant. This is the world's largest single installation for producing fresh water from the ocean, as well as the first conversion plant to produce marketable by-product electricity.



Singmaster & Breyer, New York engineers who designed and built the recently-completed plant, decided to start production of fresh water before applying insulation to the hot surfaces (215 deg F) of the thirty-five evaporators—each 11 ft in diameter by 30 ft long—or to the deaerators and main steam piping.

Applying block insulation to the cold evaporators before start-up would have taken several months because of the size of the job, the many irregular projections on the equipment, and the shortage of trained labor. Singmaster & Breyer then developed and successfully applied what is believed to be a unique method of blowing granulated insulation onto hot surfaces. This method promised substantial cost savings. Granular material is cheaper than block, and untrained workmen can be quickly taught to apply it (in Aruba, as in many foreign lands, all-round insulation men are scarce).

A total of 80,000 lb of lightweight Johns-Manville expanded vermiculite insulation was forced through a standard Gunite cement gun nozzle by 100 psig compressed air. Water was introduced at the nozzle tip and the resulting mix hit the hot metal surfaces with high velocity. There was no rebound, no steaming, and adhesion was so good that the vermiculite can now be removed only with chipping hammers. After placement of the insulation to an average thickness of two inches, workmen troweled the surface smooth and then weathercoated it with Johns-Manville Insulkote, a heavy premixed black asphalt.

Plastic Flashing Under Pool Shields Rooms Below

The apron of the University of Michigan's women's indoor swimming pool, built in 1953, forms a roof for several rooms used mainly to house mechanical equipment. Any leaks could cause costly damage.

Contractor J. B. Duke, president of Wolverine Roofing Co., Ann Arbor, Mich., applied a new elastic flashing, called Saraloy 400, and manufactured by Dow Chemical Company. In addition to preventing water penetration, the plastic can be applied quickly on the job to virtually any shape or material, and its elasticity is said to prevent

any loss of bond during expansion and contraction. Sheets of the material can be chemically joined to give a permanent, waterproof, elastic seam stronger than the base material itself.

Mr. Duke used the material to cover the area from the edge of the spectator's gallery at the pool into the pool gutters, as well as under all walks in the pool area. To prevent leakage at any edge, he turned the sheets into the gutters, and up 3 inches around the spectators' gallery. Concrete was poured first, the flashing was installed over it, and a final covering of concrete was then laid down.

The success of the Michigan pool experiment, as well as other successful installations, convinced the company of the worth of the product, which was marketed nationally in 1958.

DEGREE-DAYS FOR APRIL, 1959

(A) Airport readings; (C) City office readings; (O) Readings at a point on outskirts of city

AIR CONDITIONING, HEATING AND VENTILATING's 31st Year of Publication of Monthly Degree-Day Data

City	April			Season to Apr. 30, incl., from Sept. 1		
	1959	1958	Normal	1958-59	1957-58	Normal
Abilene, Texas	183	160	113	2826	3036	2707
Albany, New York	502	481	597	6916	6256	6642
Albuquerque, New Mexico	249	354	289	4057	4372	4319
Alpena, Michigan	704	666	762	7599	7065	7366
Asheville, North Carolina	249	288	285	4017	4656	3962
Atlanta, Georgia	108	129	133	2787	3285	2806
Atlantic City, New Jersey	367	410*	468*	5002	4525*	4528*
Augusta, Georgia	(a)	108	62	(a)	2917	2138
Baltimore, Maryland	218	202	326	4186	3984	4130
Billings, Montana	616	601	564	6398	6132	6655
Binghamton, New York	518	509	570	6604	6182	6232
Birmingham, Alabama	124	116	138	2827	3233	2758
Bismarck, North Dakota	643	606	657	8589	7826	8496
Block Island, Rhode Island	561	537	603	5527	5017	5385
Boise, Idaho	421	509	453	4872	5243	5549
Boston, Massachusetts	476	481	534	5728	5094	5506
Buffalo, New York	562	498	636	6588	6154	6405
Burlington, Iowa	432	417	425	6112	6127	5888
Burlington, Vermont	594	580	681	7795	6962	7420
Cairo, Illinois	190	190	182	3861	4120	3709
Charleston, South Carolina	55	75	43	1851	2328	1769
Charlotte, North Carolina	145	165	172	3190	3594	3176
Chattanooga, Tennessee	171	178	179	3524	3863	3339
Cheyenne, Wyoming	767	774	717	6663	6773	6855
Chicago, Illinois	466	406	507	6135	5904	6023
Cincinnati, Ohio	231	271	314	4419	4641	4424
Cleveland, Ohio	451	413	531	5885	5668	5727
Columbia, Missouri	318	325	326	4901	5227	4958
Columbia, South Carolina	95	113	77	2609	3006	2284
Columbus, Ohio	348	360	408	5290	5292	5102
Concord, New Hampshire	577	574	660	7250	6367	7146
Concordia, Kansas	363	397	341	5217	5477	5157
Dallas, Texas	141	108	75	2444	2584	2272
Dayton, Ohio	(a)	401	435	(a)	5677	5373
Denver, Colorado	572	606	525	5532	5528	5765
Des Moines, Iowa	447	445	438	6364	6414	6183
Detroit, Michigan	486	457	558	6264	5922	6085
Devils Lake, North Dakota	731	651	750	9295	8490	9301
Dodge City, Kansas	370	439	347	5006	5246	4908
Dubuque, Iowa	557	526	543	7343	6971	6892
Duluth, Minnesota	813	717	801	9276	8470	8730
Elkins, West Virginia	442	478	477	5769	6053	5456
El Paso, Texas	86	116	110	2406	2758	2641
Ely, Nevada	598	796	639	6320	6921	6759
Escanaba, Michigan	773	688	804	8189	7386	7863
Evansville, Indiana	264	291	251	4631	4869	4264
Fargo, North Dakota	649	588	687	8564	7837	8769
Fort Smith, Arkansas	179	146	127	3412	3537	3164
Fort Wayne, Indiana	470	451	516	6243	6071	5991
Fort Worth, Texas	143	138	90	2549	2797	2356
Fresno, California	38	183	145	1973	2531	2489
Galveston, Texas	41	13	30	1332	1382	1211
Grand Junction, Colorado	369	468	402	4972	5287	5628
Grand Rapids, Michigan	580	518	606	6880	6523	6647
Green Bay, Wisconsin	663	629	696	8136	7457	7715
Greensboro, North Carolina	208	244	241	3875	4264	3760
Greenville, South Carolina	141	175	161	3048	3620	3028
Harrisburg, Pennsylvania	307	339	423	5250	5189	5116
Hartford, Connecticut	463	475	528	6188	5679	5893
Havre, Montana	628	574	697	7793	7090	7717
Helena, Montana	651	679	654	7404	6970	7606
Houston, Texas	(a)	18	27	(a)	1493	1276
Huron, South Dakota	543	564	558	7634	7110	7517
Indianapolis, Indiana	397	386	432	5656	5683	5405
Jackson, Mississippi	127	89	81	2498	2823	2202
Kansas City, Missouri	273	288	292	4557	4954	4769
Knoxville, Tennessee	182	188	196	3607	3959	3540
La Crosse, Wisconsin	519	484	552	7544	6961	7295
Lander, Wyoming	641	712	687	7094	7113	7714
Lewiston, Maine	624	643	693	7291	6518	7318

(a) Data not available.
* Figures based on City office readings.
Normal figures in this table are based on 30-year period covering 1921 to 1950, inclusive, as compiled and published by the U. S. Weather Bureau.

Figures in this table, with two exceptions, based on local weather bureau reports. Exceptions are Utica and Lewiston, figures for which are furnished through the courtesy of Coke Sales Department, Central New York Power Co., Utica, N. Y., and Norman E. Ross, Bursar, Bates College, Lewiston, Me., respectively.

Degree-Days for April, 1959 (Concluded)

(A) Airport readings; (C) City office readings; (O) Readings at a point on outskirts of city

AIR CONDITIONING, HEATING AND VENTILATING's 31st Year of Publication of Monthly Degree-Day Data

City	April			Season to Apr. 30, incl., from Sept. 1		
	1959	1958	Normal	1958-59	1957-58	Normal
Lincoln, Nebraska	393	417	377	5542	5741	5654
Little Rock, Arkansas	146	132	122	3030	3201	2964
Los Angeles, California	29	83	129	684	878	1364
Louisville, Kentucky	222	247	285	4357	4668	4340
Lynchburg, Virginia	230	289	289	4107	4564	4066
Macon, Georgia	75	81	62	2172	2592	2049
Madison, Wisconsin	557	545	573	7517	6956	6915
Marquette, Michigan	787	672	789	7942	7312	7707
Memphis, Tennessee	155	154	139	3204	3582	3113
Meridian, Mississippi	107	82	85	2575	2799	2324
Milwaukee, Wisconsin	592	575	621	7187	6859	6693
Minneapolis, Minnesota	530	507	570	7374	7054	7489
Moline, Illinois	462	435	453	6328	6389	6112
Montgomery, Alabama	78	74	80	2171	2598	2137
Nashville, Tennessee	192	204	186	3722	4095	3470
New Haven, Connecticut	485	488	567	5793	5340	5695
New Orleans, Louisiana	27	20	19	1298	1555	1175
New York, New York	365	364	456	4981	4704	4879
Newark, New Jersey	343	355	450	5051	4802	5093
Norfolk, Virginia	180	242	265	3302	3655	3395
North Platte, Nebraska	550	594	489	6409	6582	6227
Oak Ridge, Tennessee	211	231	227	3880	4017	3970
Oakland, California	146	226	282	1898	2294	2671
Oklahoma City, Oklahoma	248	288	169	3860	4115	3481
Omaha, Nebraska	426	419	389	5947	5998	5948
Parkersburg, West Virginia	303	324	347	4921	5065	4618
Peoria, Illinois	418	381	435	6004	5938	5843
Philadelphia, Pennsylvania	277	297	369	4550	4468	4430
Phoenix, Arizona	0	68	62	1112	1437	1492
Pittsburgh, Pennsylvania	338	351	402	5163	5159	4898
Pittsfield, Massachusetts	595	585	690	7298	6764	7165
Pocatello, Idaho	512	639	561	5811	6397	6523
Portland, Maine	653	630	693	7390	6344	7099
Portland, Oregon	336	362	347	3472	3412	3847
Providence, Rhode Island	473	509	570	5893	5360	5783
Pueblo, Colorado	486	504	456	5260	5198	5479
Raleigh, North Carolina	179	210	172	3520	3896	3046
Rapid City, South Dakota	643	617	615	6589	6436	6974
Reading, Pennsylvania	294	323	411	5052	4912	4921
Red Bluff, California	36	193	177	1863	2775	2495
Reno, Nevada	435	589	519	5016	5484	5465
Richmond, Virginia	212	266	271	3869	4244	3889
Rochester, New York	545	509	615	6738	6315	6477
Roswell, New Mexico	212	226	185	3540	3621	3396
Sacramento, California	45	171	196	1760	2465	2510
St. Joseph, Missouri	363	349	297	5336	5585	4591
St. Louis, Missouri	258	251	270	4462	4736	4368
Salt Lake City, Utah	404	527	453	4967	5406	5552
San Antonio, Texas	90	22	34	1768	1816	1579
San Diego, California	29	79	151	676	838	1416
Sandusky, Ohio	449	439	513	5930	5760	5601
San Francisco, California	213	235	279	1650	1998	2275
Sault Ste. Marie, Michigan	864	699	846	8795	7797	8517
Savannah, Georgia	60	73	43	1884	2395	1710
Scranton, Pennsylvania	429	478	516	6325	6140	5798
Seattle, Washington	378	377	396	3718	3408	3991
Sheridan, Wyoming	690	698	645	7134	6630	7287
Shreveport, Louisiana	127	87	61	2392	2468	2117
Sioux City, Iowa	470	475	474	6652	6479	6705
Spokane, Washington	517	596	561	5932	5630	6331
Springfield, Illinois	364	354	350	5477	5574	5084
Springfield, Missouri	305	317	295	4526	4850	4551
Syracuse, New York	516	496	570	6794	6272	6207
Toledo, Ohio	485	465	555	6341	6066	6077
Topeka, Kansas	361	311	295	5098	5045	4794
Trenton, New Jersey	334	339	429	5040	4812	4924
Tulsa, Oklahoma	196	194	173	3586	3854	3540
Utica, New York	445	502	588	6717	6307	6543
Valentine, Nebraska	597	618	543	6876	6777	6683
Walla Walla, Washington	335	405	338	4295	4141	4639
Washington, D. C.	235	261	314	4156	4407	4178
Wichita, Kansas	300	334	280	4627	4940	4463
Williston, North Dakota	658	582	663	8447	7660	8499
Winnemucca, Nevada	533	620	546	5554	5921	5942
Yakima, Washington	426	498	408	5439	5143	5580

For footnotes, see page 112.

BOOK REVIEWS

Publications abstracted in this department should be ordered direct from publisher.

WINTER AIR CONDITIONING

Winter Air Conditioning, a companion volume to the popular Summer Air Conditioning, was written by the same group of authors—S. Konzo, J. R. Carroll and H. D. Bareither, all of the mechanical engineering department of the University of Illinois.

It is intended for heating contractors and others who are concerned with the science and art of residential and small building heating.

Although the technical background required for full understanding of this text includes no more than ordinary arithmetic and some slight acquaintance with elementary physics, the book is by no means a mere introduction to the subject. The authors lead the beginner through such elementary puzzlers as temperature scales, relative humidity, how to read tables and curves. And the intermediate trainee will appreciate such coaching details as a list of equipment needed to make floor plans, clear illustrations of sills, beams, joists, studs, and their relation to heating equipment, common methods of applying insulation, how to predict performance of circulating pumps and fans, and hundreds of other items that he must make his own common knowledge.

The engineer will find himself frequently referring to this book not only for the half-forgotten detail required for a new job, but also for the wealth of working data such as heat loss factors for various walls, design temperatures for hundreds of U. S. and Canadian cities, degree-days and how to estimate fuel consumption, work sheets for heat loss calculations, radiator selection, duct sizing, and much more.

Furnaces and boilers must be tailored to the needs of individual houses. Dealers and installers must be trained to make each unit, with its ducting or piping system, an integral part of each particular building. This book is designed to accomplish that training, insofar as that can be done without field experience. Each chapter ends with problems and exercises for which answers are given in an appendix. There is a glossary and complete cross-index.

Much of the material in this book is the result of more than forty years of intensive sponsored research at the University of Illinois. The authors have used, by permission, some basic material with key figures and charts based on publications of the sponsoring organizations. These publications include design manuals of the National Warm Air Heating and Air Conditioning Association, installation guides of the Institute of Boiler and Radiator Manufacturers, circulars of the University of Illinois Small Homes Council, and technical papers of the Engineering Experiment Station. Important information from many authoritative sources is thus made available in one volume that covers winter air conditioning.

Winter Air Conditioning, by S. Konzo, J. R. Carroll and H. D. Bareither. Cloth bound, 6 x 9 inches, 640 pages. Published by The Industrial Press, 93 Worth St., New York 13, N. Y. Price, $8.

POWER PLANT THEORY AND DESIGN

The second edition of Power Plant Theory and Design by Philip J. Potter, head professor, department of mechanical engineering, Alabama Polytechnic Institute, has just been issued. The first edition, published in 1949, has been thoroughly revised and rewritten.

Intended as a basic textbook, it covers the whole range of power generating equipment. While considered suitable for two-semester courses, it can be adapted to shorter courses without loss of continuity.

Principal attention is given to large central power station design because such stations include all the problems of method and equipment that would be involved in the design of industrial plants and smaller power plants.

Problems and examples have been taken from practical situations whenever that has been possible. The proper selection of pipe sizes, insulation thickness, heating terminal differences and station pressures and temperatures are fully discussed. Also included in the book is the economic sizing of condensers and the economics of variable speed versus constant speed fans and pumps.

Power Plant Theory and Design (second edition) by P. J. Potter. Cloth bound, 6 x 9 inches, 710 pages. Published by The Ronald Press Company, 15 E. 26th St., New York 10, N. Y. Price, $10.50.

AIR CONDITIONING, HEATING, VENTILATING

One of the well known books in its field, is Modern Air Conditioning, Heating and Ventilating by Willis H. Carrier, Realto E. Cherne, and Walter A. Grant. Dr. Carrier died in 1950, and for the third edition, which has just been published, William H. Roberts, senior development engineer, Carrier Corp., has been added as one of the authors. His experience on the faculties of Northwestern Technological Institute and New York University has aided in increasing the value of this book as a teaching text. The number of problems has been doubled as compared to the previous edition.

Modern Air Conditioning, Heating and Ventilating by W. H. Carrier, R. E. Cherne, W. A. Grant and W. H. Roberts. Cloth bound, 7 x 10 inches, 592 pages. Published by Pitman Publishing Corp., 2 W 45th St., New York 36, N. Y. Price, $12.

• • •

RESULTS OF CORROSION TESTS—Corrosion tests on metallized coatings have been going on for a number of years. Over 4300 specimens were exposed at 8 test sites to determine the life of each coating in special environments. Panels are to be examined at 3, 6 and 9-year intervals. Results of the first 3-year study are published in a report and may be obtained by writing the American Welding Society, 33 W. 39th St., New York 18, N. Y. Price, 50 cents.

• • •

PACKAGED FIRETUBE BOILER RATINGS—Prepared for consulting engineers, architects and governmental agencies interested in housing, the Packaged Firetube Branch of American Boiler and Affiliated Industries has made available a book covering Packaged Firetube Boiler Ratings. For a copy write to American Boiler and Affiliated Industries, Room 2502, 15 Park Row, New York 38, N. Y. Price, $1.

NEWS OF EQUIPMENT AND MATERIALS

Use the convenient prepaid postcard appearing on the last page for securing additional information about new equipment and materials described herein.

Year-Round Room Temperature Control for Multi-Story Buildings

A new type air conditioning and heating system for multi-story buildings, which permits control of individual room temperatures, has been developed by York Div., Borg-Warner Corp., York, Pa. It is termed the Three Pipe Hi-I system and the first system of this design is now in the process of being installed in the 1300-room Statler Hilton Hotel in Boston, Mass.

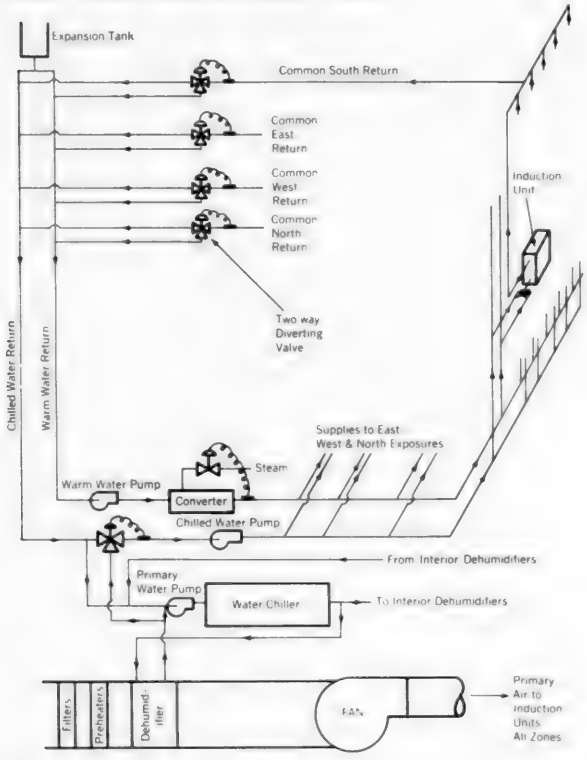


Fig. 1. (Above) Diagram of piping and duct layout for high induction three pipe system.

The three pipe system gets its name from the fact that each room unit is served by a line serving chilled water, one delivering hot water, and by a common line which acts as a return in line for whichever of the two temperature liquids is passing through the unit. In the mechanical room, one pump delivers the chilled water and one the warm water. No duplication of pump sets is required to provide zoning.

The high induction unit which is installed in each room is essentially a cabinet in which are housed the copper heat transfer coil, the necessary controls, copper tube connections to the chilled and warm water risers, and a tube at the bottom of the cabinet which connects to the riser that supplies dehumidified primary or ventilating air. This air is discharged into the cabinet through a line of small nozzles which, in assembly, resembles the ports of a gas burner. As the air is discharged through these nozzles it induces or draws in a quantity of room air so that the two air supplies are mixed before being discharged from the high induction unit, through a filter into the room. A copper tube from the unit serves as a return and this connects with a return riser in the building.

The primary air which is delivered to the induction unit from a central system provides (1) ventilation, (2) dehumidification, and (3) the motive force necessary to circulate room air over the induction unit coils since the units do not have fans.

All of the secondary water return risers for each zone are connected into a single zone return main. Depending upon whether the water in the zone return main is relatively warm or relatively cold, it will be returned either to the heating or the chilling apparatus. This is accomplished by a single automatic two-position diverting valve. When the return from a zone is over 75 deg F,

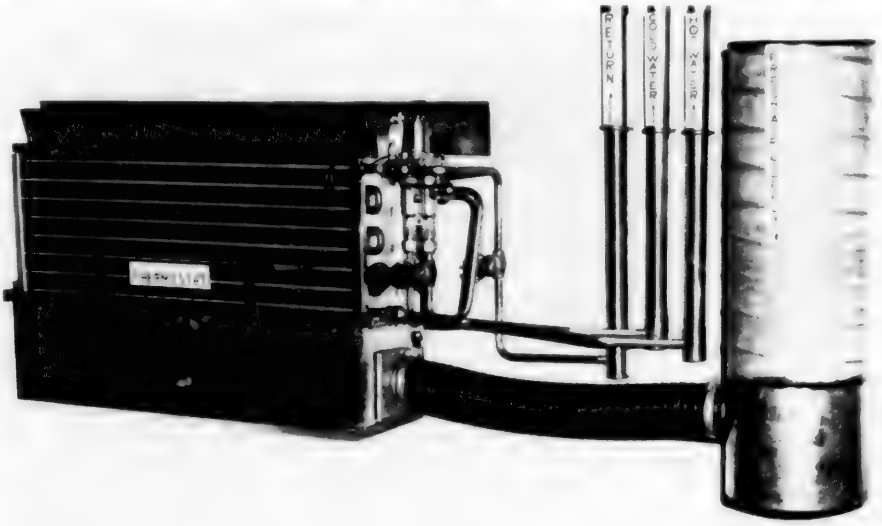


Fig. 2. Assembly of room unit to show component parts of system.

Room Temperature Control

(Continued from page 115)

it will be directed to the main warm water line leading to the heating apparatus. When below this temperature reading, it is directed to the main cold return line leading to the chilling apparatus.

Maximum economy is obtained by grouping into a zone those spaces which have similar load characteristics. Each building will have a minimum of four return water zones—one for each exposure.

A feature of this system is that there is no mixing of warm and chilled water passing through an induction unit in order to achieve a desired temperature condition. Should the valve controlling the chilled water flow be opened, then automatically the valve controlling the flow of warm water is closed. The reverse also holds true. However, it is possible to open automatically a valve partially or fully in order to control the water flow through the induction unit, and thereby obtain a greater or lesser heating or cooling effect. When neither heating or cooling is required, there is no flow of water through the induction unit.

This system comes with various size induction units in order to provide thirty capacity sizes through five coil lengths, single or double coil design, and three nozzle arrangements.

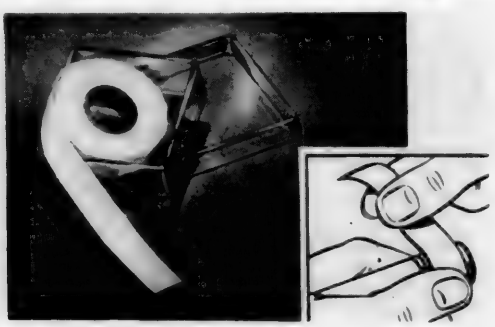
The water piping and ductwork arrangement for a typical building with north, south, east and west exposures is shown in Fig. 1. The assembly of a room unit is shown in Fig. 2.

Makers of this system claim that this design results in a saving in required floor space and in low operating costs.

More information? Circle Item 37, postcard, last page

Tape-Type Pipe Joint Sealer

A new pipe joint sealer in tape form, made from duPont Teflon, positively seals all types of threaded connections under the most difficult service conditions. It will safely handle most industrial acids, corrosives, caustics, hydraulic fluids and aromatic fuels. It is also recommended for alkalis, toxics, biological and gas service.



Temperature range is from —250 to +500 deg F at pressures to thousands of pounds.

Known as Thred-Tape, and manufactured by Crane Packing Co., Morton Grove, Ill., it can be used on plastic, aluminum, stainless steel, ceramic, synthetic rubber and carbon pipe. It prevents seizing and galling, is self-lubricating, and allows connections to be drawn up to a greater degree of tightness. It never hardens, thus permitting easy disassembly of joints even after years of service.

Sealer is available in ½ inch by 288 inch rolls, and is easily applied by wrapping tightly around the male threads. Simple instructions include manufacturer's recommended tape lengths for all standard sizes. A rigid, clear plastic box protects the tape and provides a convenient package for handy shelf or tool kit storage.

More information? Circle Item 38, postcard, last page.

Vertical Exhaust Ventilator

A high capacity industrial power unit, for vertical discharge of exhaust fumes, smoke, dust-laden and foul air, up and away from buildings, is announced by Western Engineering & Mfg. Co., Venice, Calif.

Unit is equipped with motor, direct-driven fan, venturi throat section for less air turbulence, and butterfly

dampers which automatically open and close with fan. Neoprene seal assures positive closure. If required, fusible link will open dampers automatically in case of fire to minimize smoke and fire damage.

Factory-sealed wafer motors are said to require no lubrication or maintenance. Sizes range from 24 to 48 inches, from ¼ to 5 hp.

More information? Circle Item 39, postcard, last page.

Compressor Surge Control System

CDC Control Services, Inc., Hatboro, Pa., announces a new, fast-responding CompuDyne surge control system, for large compressors, blowers, and exhausters, which improves the operating stability, reduces power consumption, and increases the safe output of such equipment. With the system, compressors can be safely operated nearer the surge point than was before possible. Unchecked surging can quickly damage or destroy a compressor, the company states.

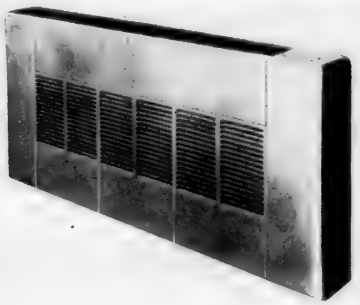
Adaptable to every mode of compressor operation, the system can be used on units from 50 hp up. It is a highly flexible, completely packaged system providing complete safety at any level of compressor operation.

More information? Circle Item 40, postcard, last page.

Low Pressure Air Conditioners

An improved line of American Blower low pressure Inductor air conditioners, for application to perimeter areas of multi-room buildings using conventional duct-work, is available from American-Standard Industrial Division, Detroit, Mich.

These units provide heating, humidification, cooling and dehumidification for the perimeter areas of office buildings, laboratories and various other multi-room



structures that require relatively large volumes of air for ventilation. The line is available in five unit sizes: 20, 28, 36, 48 and 60—the numbers designating tube length of the secondary coil in inches. Up to 700 cfm of fresh air can be supplied by each low pressure air conditioner.

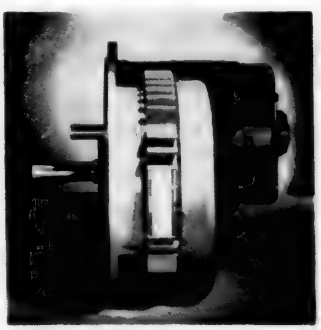
Individual room control of primary air is provided by a standard indexing and locking device for fixing unit volume. This control can be field set as required. It also can be manually operated through a remote control arrangement if desired. The secondary coil, either hot water or steam, can be controlled manually by a hand valve from the standard access door. Automatic electric or pneumatic control valves can be used, but must be installed on the job.

More information? Circle Item 41, postcard, last page.

Shorter, Lighter Fan Motor

A new motor that is up to 55% shorter and 26 lb lighter than standard NEMA Type "D" flange motors of the same rating is introduced by General Electric Co., Schenectady, N.Y.

Designed for such applications as machine tools, fans, blowers and food disposers, the Thinline motor meets industry requirements for more horsepower in less space. The motor reduces motor overhang, take up less aisle space than standard flange-mounted motors, increases elbow room for the machine operator, and allows more compact design of equipment such as ventilating fans. Lighter weight of the motor makes it easy to install on original equipment and reduces unit shipping costs.



According to company engineers, the new design meets NEMA design "B" specifications for torques and starting current, and standard NEMA frame diameters remain unchanged.

More information? Circle Item 42, postcard, last page.

Circulator Valve

A straightway circulator valve, No. 208, without unions, for use with copper tubing, has been developed by Hammond Valve Corp., Hammond, Ind.

Compactness of design is said to make it ideal for use with concealed convector type radiators and also in certain types of baseboard radiation. Valve is available in $\frac{3}{8}$, $\frac{1}{2}$, $\frac{3}{4}$, and 1-inch sizes.

A balancing fitting, No. 308, without unions, previously available only up to $\frac{3}{4}$ inch, is also now available in the 1-inch size.

More information? Circle Item 43, postcard, last page.

Cabinet Dust Collector

Model 90 cabinet cloth filter type dust collector, operating in the 650-1535 cfm range, has nearly 100% dust filtering efficiency, according to its producer, Torit Mfg. Co., St. Paul, Minn. Overall collection efficiency is said to be in excess of 99.9 per cent by weight, even with a high concentration of particles smaller than 1 micron. This high filtering efficiency permits the filtered air to be recirculated indoors with a consequent saving of conditioned air.

Dust is trapped on the outer, under sides of the fire-resistant filter bags. This eliminates possibility of fan loading or damage since the blower is located on the clean air side of the collector. Most dust settles immediately into the drawer (or hopper-base) and any clinging dust is easily dislodged by the filter shaker operated from outside the cabinet. Unit contains a pull-out drawer with 5.5 cu ft capacity. Equipped with hopper base, dust capacity is 9 cu ft. Collectors are powered by a 3-hp, 3450-rpm, 220/440v/60/3-phase vertical motor. The collector stands 76 inches high and occupies 40 by 36 inches of floor space. Total cloth filtering area is 250 square feet.

More information? Circle Item 44, postcard, last page.

Air Filter Adhesive Sprays

Research Products Corp., Madison, Wis., manufacturer of E Z Kleen aluminum washable air filters and other filters for commercial and industrial applications, now offers its Super Filter Coat adhesive in two new spray containers.

The Handi-Koter (at right in photo) is a container with a self-contained, finger-operated spray pump. The Pressure Koter (at left) is a pressurized sprayer. Both contain one pint of adhesive —enough for re-coating several average size filters.

Spray containers make re-coating filters, after washing, exceptionally easy and fast, the company reports. And because the coating is compounded with a "built-in" detergent and is water soluble, the washing process is also greatly simplified.

More information? Circle Item 45, postcard, last page.

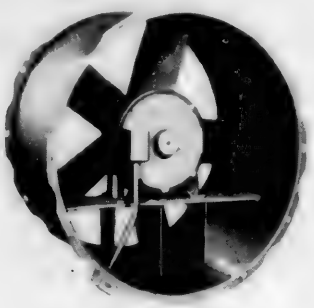
Adds Five Boilers to Line

A line of five new boilers is announced by Crane Co., Chicago, Ill. The company will continue its Sunnyday 15 boiler, and will add an oil-fired Sunnyday 5; three all-fuel Sunnydays: the 21, 31, and 41; and a gas-fired Sunnyday 36. Crane will continue to market its gas-fired boilers, manufactured by Bastian-Morley.

More information? Circle Item 46, postcard, last page.

Tubeaxial Duct Fan

A newly designed tubeaxial duct fan, as easily installed as a section of duct and using no more space, is announced by Ilg Electric Ventilating Co., Chicago, Ill. Sixteen sizes, ranging in capacity from 1040 to 21,200 cfm at static pressures up to 1½ inches, are available.



Unit can be mounted in any position. Smaller sizes feature a 3-blade propeller, and the larger, a new 5-blade design. Fan wheels are directly connected to a totally enclosed motor with permanently lubricated ball bearings, assuring maximum service life with a minimum of attention.

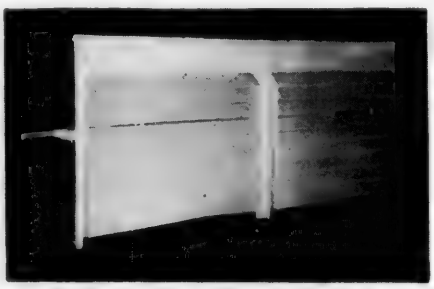
The fan unit is mounted in a rugged, welded steel housing with flanged ends forming a completely prefabricated fan and duct section.

More information? Circle Item 47, postcard, last page.

Year-Round Heat Pumps

Model 1500R, a 15-ton air-to-air type heat pump for split, year-round systems, is announced by The Forston Co., Houston, Tex.

Units boast deluxe summer-winter control, automatic defrost and reversing valves of proven performance, and a single Brunner compressor. According to the manufacturer, the unit is of simple design for quick, easy installation and servicing.



Also included in the company's 1959 line are new 2, 3, and 5-ton package models which supplement the 2, 3, 5, 7½, 10, and 15-ton split system central units for residential and commercial use. All are of the air-to-air type and are furnished either with heat pump or for cooling only.

The company also manufactures automotive air conditioners for dash and trunk mounting, for all popular makes of standard American-made automobiles. A newly designed model, the Continental Voyager, is produced for the small foreign and domestic cars with limited horsepower engines.

More information? Circle Item 48, postcard, last page.

Duct Strap Hanger

Maurlee Company, Inc., Woodbury Heights, N. J., announces development and production of a new duct strap hanger. The strap hanger is rated at 200% more rigidity than conventional hangers.

According to a company spokesman, although a strap hanger is a relatively unimportant item in the installation of warm air heat and air conditioning, the wrong size or inadequate type strap can be a source of annoyance and delay to a contractor. The new hanger is easily adjustable to any spacing between joists and any size joists. The greatly increased strength is attributed to the unique corrugated design, which increases the strength considerably while reducing cost to the minimum, the company reports.

More information? Circle Item 49, postcard, last page.

Foamed-Plastic Pipe Insulation

B-H Rigid Foam pipe insulation, the first pre-molded rigid polyurethane pipe insulating material, is said to have substantially greater thermal efficiency than any low temperature insulation now on the market. Specifically designed for low temperature application down to minus 300 deg F, the material has been thoroughly field tested and is now available nationally from Baldwin-Hill Co., Trenton, N. J.

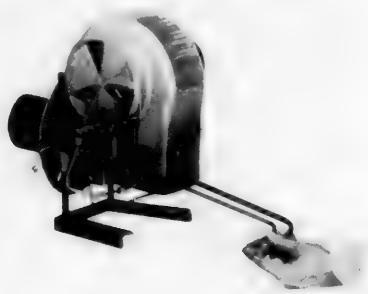
Material cost is competitive with other pipe insulations of comparable quality, but because this insulation has such a low K-factor, (0.096), substantially reduced thicknesses give the same thermal protection. At zero deg F, it need be only half as thick as any other material, the company reports. This permits savings in application time and in finishing materials required. Job reports indicate cost of installation averages about 30% less than with competitive materials.

More information? Circle Item 50, postcard, last page.

Gas Conversion Burners

The Barber Manufacturing Co., Cleveland, Ohio, announces a new series of power (forced draft) inshot gas conversion burners, called the Contractor series. These burners come in two basic models with AGA-listed inputs, respectively, of 75,000 to 225,000 Btu per hr, and 150,000 to 400,000 Btu per hr.

Burners are available in 5, 8, 10 and 15-inch usable blast tube lengths, have tube diameters of just 4 inches, and are provided with either adjustable flange or stand



mountings. These features make them adaptable to almost any furnace, boiler, or hot-water heater application rated up to 400,000 Btu per hr.

An adjustable orifice permits exact setting of Btu input by turning the needle-type orifice assembly with a special tool provided. Also, separate adjustment of primary air and secondary air allows the installer to adjust the flame exactly to the combustion chamber.

Of special note to installers is the ease of pilot assembly removal (see illustration). With the burner installed, removal of the pilot assembly is made by removing the back plate, disconnecting the pilot tubing and thermocuple connection and drawing straight back.

More information? Circle Item 51, postcard, last page.

Off-Floor Water Cooler

Described by the manufacturer, Temprite Products Corp., Birmingham, Mich., as a new design-engineering concept in self-contained electric drinking water coolers. Wall-Temp Model WT-13 mounts flush to the wall and off the floor. Plumbing is fully concealed within the cooler cabinet.

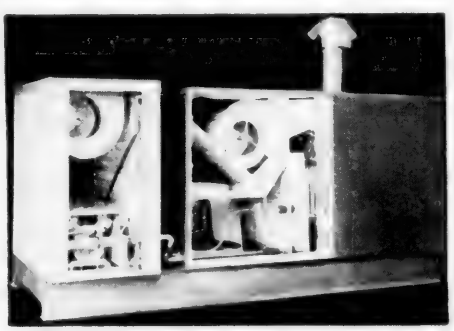
At normal 40-inch bubbler-to-floor mounting height, there is a full 17-inch clearance from the bottom of the cooler to the floor, providing complete ease of floor maintenance at the unit. It can also be mounted at any desired lower height to accommodate children within any age bracket.

Unit measures an exceptionally compact 15¾ inches wide by 13 inches deep at top—recessed to 9 inches deep at bottom. Overall height is 24 inches. In spite of its size, the cooler delivers a full 13 gph of 50 deg water at standard ratings.

More information? Circle Item 52, postcard, last page.

Roof-Mounted Year-Round Unit

Ventil-Aire is a roof-mounted air conditioning unit that both heats and cools one-story buildings. Offered by Service Engineering & Refrigeration Div., Ventil-Aire Metal Fabricating Corp., Ridgewood, N.Y., its installation is simplified by inclusion of the necessary through-the-roof duct and ceiling diffuser with the package.



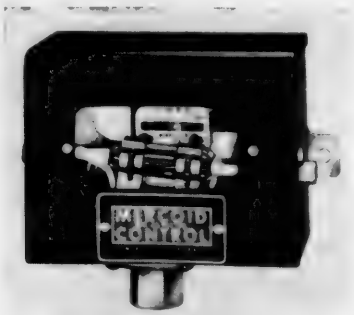
A remote acting thermostat controls both the heating and the cooling cycle, the entire system being self-contained, air cooled, and factory wired. System includes a Westinghouse compressor and Reznor gas furnace with automatic electrical ignition. Oil fired models are complete with induced draft fan, prepurge and postpurge cycle, and have all stainless steel combustion chambers.

Units are available in 5, 7½, and 10-ton capacities. They feature extra-large, 4-row, heavy-duty cooling coils. Typical applications are: supermarkets, bowling alleys, one-story industrial plants, variety stores, and banks.

More information? Circle Item 53, postcard, last page.

1¾-Lb Pressure Controls

Type AP-153 pressure controls, designed by The Mercoid Corp.. Chicago, Ill., are recommended by the manufacturer for applications involving air, liquids or gases not injurious to steel or silver solder. Their small size, 4⅛ by 3⅛ by 2⅞ inches, and light weight, 1¾ lb, are said to make them particularly suitable for mounting where limited space is available or for mounting on wiring channels.



Features include external adjustment, repetitive trip point, visible calibrated dial with pointer, and visible hermetically sealed mercury contact. Adjustable operating range is for 1-20 psig with fixed 0.5-psig differential. Maximum pressure is 30 psig. Hermetically sealed mercury switch provides for either single pole, cut in high (close on rise); single pole, cut in low (open on rise) or single pole, double throw.

More information? Circle Item 54, postcard, last page.

Electric Atomizing Humidifiers

A new line of electric atomizing humidifiers, which features portable and permanently installed models, is announced by Skuttle Manufacturing Co., Milford, Mich. All units operate on an aerosol principle, which is the atomizing of water in the form of aerated minute particles by cold mechanical centrifugal ejection of dry mist into the air stream.

Model 504 (illustrated) is a portable, plug-in unit, with an atomizing capacity of 1½ to 1¾ pints of water per hour. It can be connected to any standard electrical outlet. This model has been designed for applications up to 12,000 cubic feet.

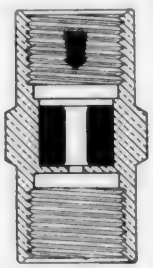
Model 2001 is designed for plenum installation in any warm air heating system. It has a reservoir capacity of over a half-gallon of water, and will maintain the relative humidity at 35 to 45% in homes up to 30,000 cubic feet, even when outside temperatures go below zero. Ease of cleaning is one of the many advantages claimed by the manufacturer. The entire unit can be disassembled outside the plenum by hand; no tools are required.

Models 3001 and 6000 are designed for commercial and industrial applications. Model 3001 claims a capacity of over one gallon of water per hour, while Model 6000 is said to have an output capacity of over two gallons of water per hour.

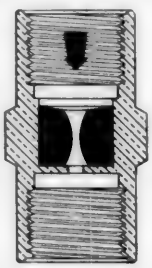
More information? Circle Item 55, postcard, last page.

New Flow Regulators

Taco Heaters, Inc., Cranston, R.I., announces a new line of flow regulators in eight sizes from 2 gpm through 8 gpm. Bodies are brass and tapped ½ inch for sizes



Flow Control Under Minimum Inlet Pressure



Flow Control Under High Inlet Pressure

through 4 gpm, and ¾ inch for the larger sizes.

Control is obtained by the change in size and shape of the orifice, in the specially compounded and sized rubber member, as indicated under the illustrations.

Orifice is self-cleaning by the continual flexing of the rubber member. Regulators are accurate to a maximum of 10% plus or minus of the rated size when used within the range of 20 to 125 psi, and are suitable for temperatures to 160 deg F.

More information? Circle Item 56, postcard, last page.

Plastic Pipe for Wells

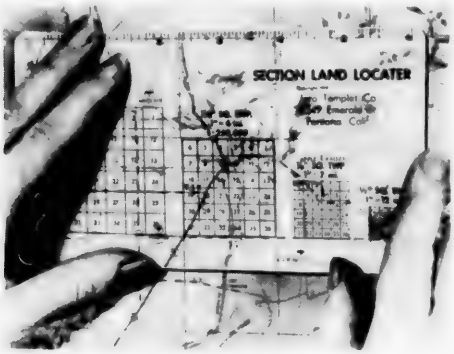
Golden Jet polyethylene piping, backed by a five-year guarantee, is manufactured by Yardley Plastics Co., Columbus, Ohio, from a new high-strength compound produced by Allied Chemical. Piping is engineered specifically for shallow and very deep water wells and can be used with all types of single and multi-stage jet pumps.

Available in coils of 100 and 300 ft, pipe owes its strength to a molecular structure consisting of chains of 70,000 carbon atoms. compared to the usual polyethylene chain of 2,000 carbon atoms. (Insert fittings, made of nylon in 1, 1¼, and 1½-inch diameters are manufactured for use with the pipe.) Recommended working pressure is 40 psi at 195 ft pumping water level; 50 psi at 170 ft, and 60 psi at 150 ft.

More information? Circle Item 57, postcard, last page.

Section Land Locater

A transparent plastic template, which instantly locates any section of land or township drawn maps, is offered by Jero Templet Co., Fontana, Calif. It fits eight of



the most commonly used map scales, four on each template. Size is 3¾ by 6¾ inches, to fit pocket or ring binder.

More information? Circle Item 58, postcard, last page.

Schedule 40 Aluminum Pipe

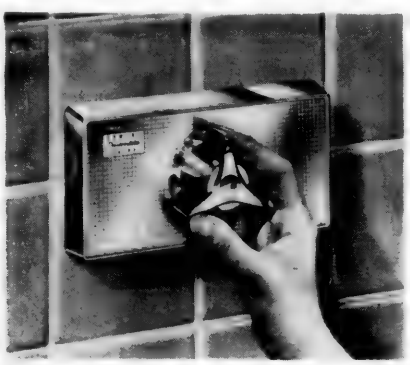
Reynolds H-E Pipe, a thick-jointed aluminum pipe originated by Reynolds Metals Co., Richmond, Va., is available in a complete range of Schedule 40 equivalent sizes. The Schedule 40 equivalents are in addition to Schedule 80 equivalent sizes obtainable when the product was introduced last December.

The new sizes are being produced in response to requests from oil, chemical and processing firms. Pipe walls are tapered in thickness to provide extra strength at the joints while eliminating excess metal in the pipe body. Available in 30- and 40-ft lengths, it can be used interchangeably with other standard aluminum pipe.

More information? Circle Item 59, postcard, last page.

Low-Capacity Water Mixer

Hot water savings plus improved response for bather comfort and safety are provided by a new low-capacity thermostatic water mixer for showers and tubs. Called



Hydroguard Type H-5, the mixer is made by The Powers Regulator Co., Skokie, Ill., and is seen having use in houses, apartments, hotels, clubs, schools, and industrial shower rooms.

The mixer has a 5-gpm capacity to match the performance of most shower heads. Previously the 10-gpm model was the smallest mixer available.

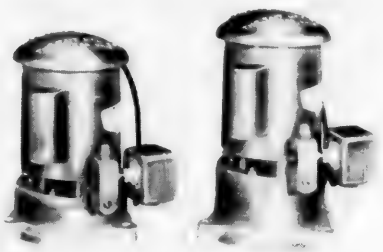
Mounted on shower or tub wall, the mixer takes the place of conventional hand valves. Hot and cold water are thermostatically mixed in the unit to provide delivered water at the temperature dialed by the bather.

More information? Circle Item 60, postcard, last page.

Vertical Jet Pumps

Single and two-stage vertical jet pumps are added to the line of low-cost Rapidayton Jetstars made by The Tait Manufacturing Co., Dayton, Ohio.

These pumps are especially suited to single-pipe applications on 2, 2½, and 3-inch wells. The single-stage



model is available in ⅓ and ½ hp, is designed for wells 20 to 80 ft in depth, and delivers up to 810 gph. The two-stage pump is equipped with ½, ¾, and 1-hp motors, reaches to 150 ft, and gives up to 965 gph. The two impellers give full capacity at 40 psi pressure.

Pump is reported as easy to install because of company's recessed base which fits directly over the well casing on double-pipe installations, or bolts directly on single-pipe well adapter.

More information? Circle Item 61, postcard, last page.

Differential Pressure Regulators

Atlas Valve Co., Newark, N. J., announces the availability of two differential pressure regulators for steam service. The first, Fig. 1200, Type C, controls atomizing steam pressure at an adjusted value higher than fuel oil pressure. The other, Fig. 1210, Type C, controls atomizing steam pressure at an adjusted value lower than the fuel oil pressure.

Both valves are available in sizes ½-2 inches inclusive, and have a number of features in common. According to the manufacturer they are easy to service and install, and have a minimum number of moving parts, requiring internal adjustments. Telltale ports indicate rupture of either steam or oil diaphragm. O-ring seals are suitable for 400 deg F.

More information? Circle Item 62, postcard, last page.

Packaged Boiler for HTW

A packaged high temperature water boiler has been developed by Boiler Engineering & Supply Co., Inc., Phoenixville, Pa. Called Flo-Kontrold, the new boiler is specifically designed for high temperature hot water heating and process work. Water is circulated at temperatures between 250 and 450 deg F with system loads from 4 million to 100 million Btu per hr.

Circuits are arranged to eliminate the possibility of vapor locking, as there are no reverse vertical down flow tube circuits. All circuits are drainable at one point through the bottom header, and vented at one point through the top header.

Correct sizing of the orifice in the inlet end of each tube maintains the required velocity of water in each tube circuit. Each tube circuit has sufficient water due to metered flow to absorb the maximum amount of heat that will contact its surface.

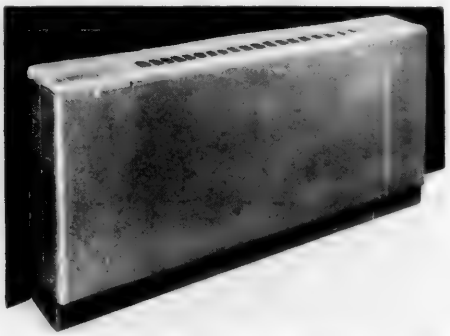
Boiler is entirely supported on a structural steel frame, and enclosed with a welded steel casing that is gas-tight for pressurized furnace firing. No special foundation or brick supporting construction is required. A nitrogen-pressurized or steam-balanced expansion drum maintains the necessary pressurization on the system. Boiler circulating pumps are optional equipment as pressure drop through boiler is from 10 to 15 psi under normal operation and design conditions.

More information? Circle Item 63, postcard, last page.

Hydronic Room Units Slimmer

Redesign of its line of Seasonmaker individual room air conditioning units by making them only 8½ inches deep and 25 inches high or wide is announced by McQuay, Inc., Minneapolis, Minn.

There are four models: ceiling, hideaway, floor and basic, each in five sizes. All utilize central station heating and cooling with capacities of 220, 330, 440, 520 and 640 cfm. The four smaller sizes are equipped with 1050-



rpm motors, while the largest has 1500 rpm. They furnish individual room comfort at any desired temperature level: heated, filtered air in the winter; cooled, dehumidified and filtered air in the summer.

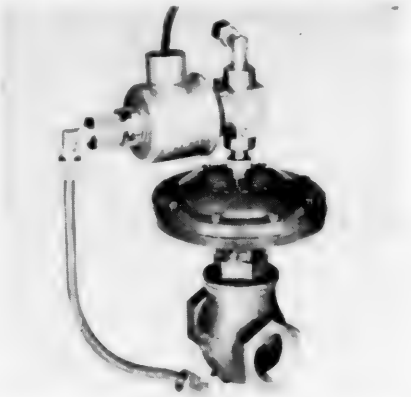
All models feature reversible coils for easy field change of either right or left hand connections. Cabinet parts are constructed of continuous galvanized steel, and the exterior parts are bonderized and finished with baked-on enamel. The large end compartments with removable panels and access doors speed installation time.

According to the manufacturer, units are ultra-quiet in operation, and are ideal for multi-room buildings, such as apartments, motels, schools, hospitals, offices and residences.

More information? Circle Item 64, postcard, last page.

Pilot Operated Diaphragm Valves

Type PO 101 pilot operated diaphragm valves are announced by Superior Controls Co., Inc., Los Angeles, Calif. They are said to be designed for maximum efficiency as a shut-off control for air, water, fuel, or high-pressure gas. They will operate over a pressure range from 30-150



psi, with temperatures of 250 deg F. A Type PO 101-A will operate up to 300 psi, and a Type PO 101-B is designed for control of steam.

Another unit, Type PO 102, is similar to Type PO 101, except that the 3-way solenoid pilot valve is operated remotely from the diaphragm valve. This valve would be used in explosive atmospheres from which electric components must be removed.

More information? Circle Item 65, postcard, last page.

Dissolved Oxygen Meter

A dissolved oxygen meter which automatically analyzes and continuously records dissolved oxygen in surface waters is available from The Hays Corp., Michigan City, Ind. Typical applications include metering dissolved oxygen in sewage and industrial plant effluents, in rivers and streams, and in water for dams.

Operating principle is based on Henry's Law which states essentially that at equilibrium, the partial pressure of oxygen above a water surface is directly proportional to the amount of oxygen dissolved in the water. Thus, the partial pressure of oxygen in the gas above the water surface is a direct measurement of the amount of oxygen dissolved in the water.

The meter consists of three basic units: Model 627 Contact Sampler, Model 631 Magno-Therm Analyzer, and Model 771 Universal Recorder.

More information? Circle Item 66, postcard, last page.

Vertical Finned Radiation

Slant/Fin Radiator Corp., Richmond Hill, N. Y., has originated a central heating system which is aimed at securing a 20% to 40% reduction in the cost of installing a central system in any marginal multiple dwelling.

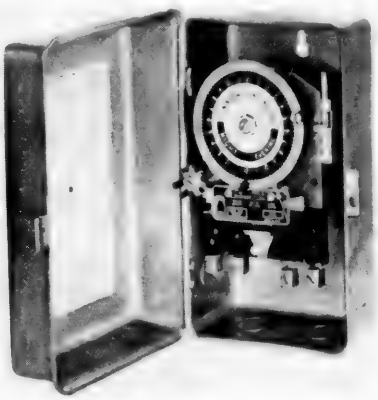
System is called VFR (vertical finned radiation) and is based on a finned steel pipe which is installed vertically in the same manner as the conventional radiator supply risers. The finned portion of the pipe extends from the floor to a height of five or six feet. These fins supply the convection for the steam which rises from the boiler, and take the place of the conventional radiator. See photo.

The output of 3.5 sq ft EDR per lineal foot provides a good temperature gradient, the company reports, with mean readings of 74 deg F at the ceiling and 68 deg at floor level. The boiler, main, and return piping installations remain the same as with conventional cast iron radiator systems.

More information? Circle Item 67, postcard, last page.

Provides for Morning Pick-Up

Model 1197 NB three-position time switch, offered by Heating Control Div., Tork Time Controls, Inc., Mount Vernon, N. Y., provides for automatic fast morning pick-up in addition to normal switching from *high* to *low* thermostat.



Previously, automatic control allowed only for switching from night set-back to day operation, and back again. This unit maintains the same three-position switching cycle each day, as preset, without need for manual attention.

An omitting device permits the elimination of heating on weekends, holidays, or any desired period of the week, without altering the master daily cycle. When set to omit weekend operation, for example, the time switch turns heating to *night set-back* Friday night and maintains that condition until Monday morning. Then, it switches to *pick-up* and starts the cycle again.

More information? Circle Item 68, postcard, last page.

400-Cycle Motors

A. Wesche Electric Co., Blue Ash, Ohio, has available 400-cycle, 3-phase induction motors. These units are currently being installed in air conditioning units manufactured by Ellis & Watts Products, Rossmoyne, Ohio.

The 400-cycle motors have full-load speeds comparable to 60-cycle motors, so that they can be applied without gearing at rpm speeds of 3,350; 3,320; 2,580; and 1,880.

Life of the motors, which range from ¾ to 15 hp, is estimated at 20,000 to 30,000 hr. This is approximately ten times that of 400-cycle gear-head motors, the motor manufacturer states. Units are the same size as regular 60-cycle motors.

More information? Circle Item 69, postcard, last page.

Root-Proof Drainage Pipe

A low cost drainage pipe, called Root-Pruf, that resists root entry and is easy to install, crush-proof, leak-proof, corrosion-prof and impact resistant, is offered by Triangle Conduit & Cable Co., New Brunswick, N. J. Made of a tough semi-rigid compound, the versatile new pipe is designed to cut the builder's costs and increase his profit margin, while offering superior service to the consumer.

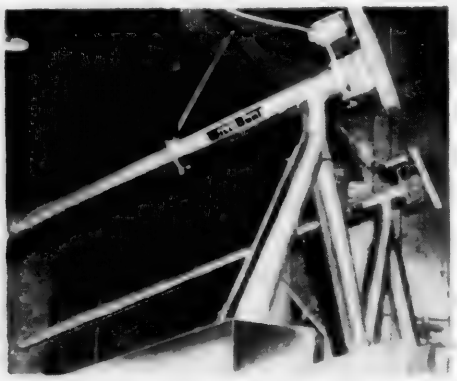
Extensive testing at the company's research department and in actual installations has completely eliminated the possibility of sewer gas leakage.

A factor which speeds up installation is the material's light weight, which permits a single man to carry up to 50 ft of 4-inch pipe. Another is the solvent weld method of joining. A complete line of fittings is available.

More information? Circle Item 70, postcard, last page.

Drive-Reversing Coal Conveyor

A self-clearing coal conveyor is announced by The Will-Burt Co., Orrville, Ohio. Two-way, switch-controlled motor drive makes it possible to eject obstructions simply by reversing coal screw rotation.



Coal screws and flanged coal screw housings are made in matched sections and can be assembled to operate at any angle, with single or dual discharge chutes. Conveyors can also be specified for horizontal, cross feed, tandem or vertical operation. Coal screws are completely free-floating. Power units are of the totally enclosed, oil-bath type.

Standard capacity is 2,500 lb per hour, based on 48 lb coal. Larger capacities are available on specifications.

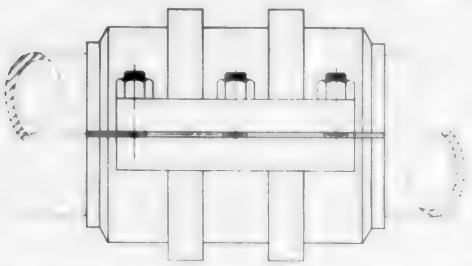
Complete specifications and installation drawings are available.

More information? Circle Item 71, postcard, last page.

Pipeline Repair Coupling

The Smith split-coupling, introduced by The Pipe Line Development Co., Cleveland, Ohio, is especially designed for pipeline repairs. Split longitudinally, it can be used as a coupling, split sleeve, or as a pipe repair clamp.

Clamping means are provided to resist endwise pull of the pipe when it is used as a coupling. Of all-steel construction, it can be welded solidly and permanently, while pipeline is in service, to become an integral part



of the pipeline. It is welded to the pipe by full encirclement welds, which are necessary on all newer high-tensile strength pipelines, whether the device is used as coupling, clamp, or sleeve.

While introduced originally to the petroleum industry, when supplied with silicone packing, the split-coupling will be adaptable to temperatures ranging from minus 60 to plus 550 deg F, making it applicable to steam and hot water lines.

A newly developed special feature, which the company calls Girdering, is said to securely hold the packing in place and at the same time protect against packing blow-outs. This makes use of silicone packings for higher pressures practical, the company states. All packing is factory installed. Coupling is available in sizes from 2 to 4 inches.

More information? Circle Item 72, postcard, last page.

Technical Fountain Pen

Techagraph is described as a technical fountain pen, a convenient instrument designed for high-speed precision pen work, ideally suited for offset printing, Thermofax machines, and other forms of reproducing. Offered by Alvin & Co., Inc., Windsor, Conn., it fills

directly from an ink bottle and is said to provide a large, continuous supply of ink.

According to the company, the pen produces sharp, uniform lines; will not leak or clog, and has a clear-view window to make ink supply easily visible. Separate nibs are available in six line widths ranging from super-fine to extra-broad.

Almost all types of inks can be used, including writing ink, India drawing ink, waterproof ink, special inks developed for fountain pens, drawing and tracing use, but *not* acetate inks. Pen is cleaned by rinsing in water.

More information? Circle Item 73, postcard, last page.

Synthetic Felt Has Many Uses

A non-woven felt made of synthetic fibers by Troy Blanket Mills, New York, N. Y., is said to be superior to natural-fiber felt in numerous applications in plumbing, air conditioning, and other phases of construction. Known as Troyfelt, it is available in commercial quantities in a wide variety of widths, thicknesses, densities, and permeabilities.

Applications in the building field, as an acoustical material; as an air, dust, or water filter; duct or pipe insulator, and as weather stripping, are in addition to other uses, such as a lining or padding for refrigeration equipment, a pump seal, etc.

According to the manufacturer, its greater strength, dimensional stability, resistance to abrasion, resistance to rot, flexibility, and other qualities result from the fact (1) it is made of synthetic fibers, and (2) these fibers are mechanically interlocked. No chemical binding agent is used.

More information? Circle Item 74, postcard, last page.

Cooling Tower Water Treatment

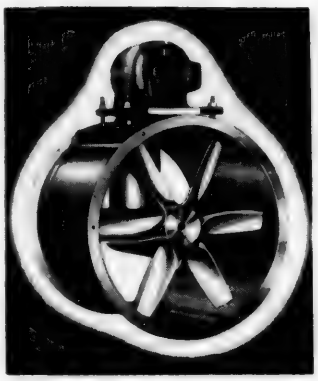
A system developed by The Bird-Archer Co., Philadelphia, Pa., provides continuous, automatic proportioning of liquid chemicals in the treatment of cooling tower water to prevent corrosion and scale formation. Eliminating the need for daily charging of chemicals, a feeder supplies as little as 1/10 to 1 gallon of specially filtered liquid chemical into the circulating water every 24 hours. One or two 55-gal drums of chemical can last a season under normal conditions, with little or no personal attention to the Bird-Archer Micro Feeder.

The device is easy to install. Control is easy to set, easy to regulate, and trouble-free, the company reports. Operation costs only pennies a day, with outside service charges eliminated and human error circumvented. There is no waste of chemicals, because feed rate is uniform, micro-proportioned only as required and when tower is in operation. A Bird-Archer test kit is furnished with the system for periodic sampling of cooling tower water.

More information? Circle Item 75, postcard, last page.

Belt-Drive Duct Fans

Variable pitch drives which permit quick and easy adjustment of fan speed, and thus of fan noise level and air volume, are standard equipment on the redesigned line of belt-drive duct fans offered by Hartzell Propeller Fan Co., Piqua, Ohio.



Simple adjustment of the driver sheave on these fans will slow the fan down to reduce air deliveries up to ⅓ where maximum performance is not required.

A second feature is complete standardization of components within each fan size. This means that a change of motors to meet changing air delivery needs requires no modification of the fan, and can be made while the fan is still in place in the duct work.

More information? Circle Item 76, postcard, last page.

Gas Heating Control Line

A complete line of controls for gas heating, including diaphragm gas valves, combination diaphragm gas valves, automatic pilots and regulators, is offered by Penn Controls, Inc., Goshen, Ind.

Diaphragm gas valves, designated Series 9100 and Series 9200, are supplied in sizes from ½ through 3 inches. Manual opening and electric reset features may be supplied in all sizes.

Combination diaphragm gas valves, automatic pilots and regulators are available in ½-inch, small, ½-inch large, and ¾-inch sizes, and may be supplied with manual opening, electric reset and 100% shut-off. Manual opening, supplied in the form of a kit, may be added to any existing combination valve.

More information? Circle Item 77, postcard, last page.

Pedestal Urinal

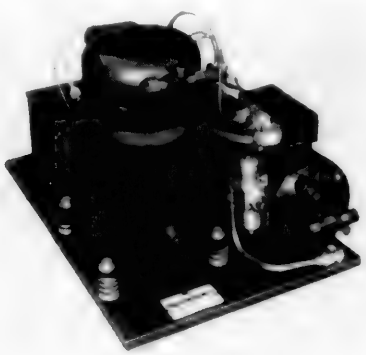
The Chalfont is a vitrous china siphon-jet pedestal urinal with 1¼-inch top spud with integral rim for use with exposed flushometer. Universal-Rundle Corp., New Castle, Pa., also furnishes it with a 1¼-inch back spud for use with a concealed flushometer.

Unit is furnished with china bolt caps. Outlet is designed for closet floor flange. Urinal may be used with flush tanks, and may be installed singly or in batteries. Its surface is said to be harder than steel. Using the company's high-fired process, the surface quality is such that it is easy to clean and will give more years of trouble-free service, the company asserts.

More information? Circle Item 78, postcard, last page.

Water-Cooled Condensing Unit

A new 2-hp model expands the line of water-cooled condensing units manufactured by Bendix-Westinghouse Automative Air Brake Co., Evansville, Ind., which now includes the entire range of sizes from ⅓ through 2 hp.

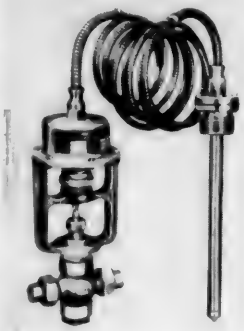


Designated Model BWRH200TA, unit delivers full 2-hp capacity for refrigerating as well as air conditioning applications. A twin-cylinder motor compressor is employed and models with either 230 volt, single-phase, or 208/220 volt, three-phase motors are available. The unit is designed for use with Refrigerant 22.

More information? Circle Item 79, postcard, last page.

Temperature Regulator Announced

Announced by Lawler Automatic Controls, Inc., Mount Vernon, N. Y., is its balanced single seat temperature regulator, a tight-closing modulating valve suitable for steam service up to 150 psig. It is available in sizes from ½ through 2-inch IPS, in bronze body with union ends.



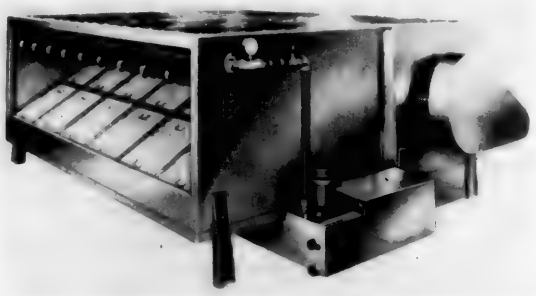
The term "balanced single seat" is derived from the fact that the line pressure on top of the main valve poppet is balanced by means of a piston attached to it. When the valve is to be opened, the pilot valve stem is lifted off its seat, admitting steam through the poppet to the chamber under the piston. This balances the thrust holding the poppet closed, and, upon further movement of the valve stem, the main valve poppet is opened. Upon closing, the valve will not slam shut because of the dashpot effect of the piston in its cylinder.

Valve is a completely self-contained unit. All working parts can be removed from the valve body without disturbing any pipe connections.

More information? Circle Item 80, postcard, last page.

Expanded Central Station Line

An expanded line of American Blower central station air conditioners, which includes high pressure models and capillary conditioners, is now available from American-Standard Industrial Division, Detroit, Mich. The central station air conditioning units are factory assembled. They are recommended for static pressures from ¼ to 9 inches of water and deliveries from 800 to 40,000 cfm.



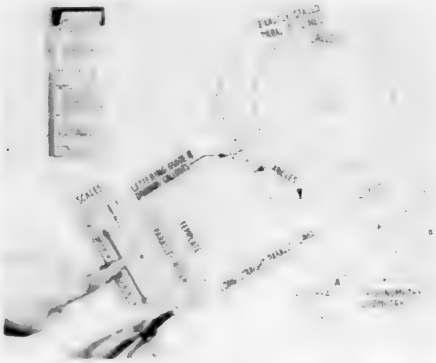
The full range of deliveries and static pressure ratings applies to the established Type A conditioner for summer cooling and dehumidifying and winter heating, the Type S sprayed coil conditioner, and Type AB multi-zone conditioner for application in multiple zone areas.

New to the line is the Type C capillary conditioner, a modification of the Type S unit. In this type, the sprays act on glass-filled capillary cells to produce highly saturated air through evaporative cooling. The capillary cell also acts as an extremely efficient air filter for removal of all normal air-borne dust, mold and spore. The Type C unit is particularly well suited for use in hospitals, pharmaceutical plants and many specialized industrial applications.

More information? Circle Item 81, postcard, last page.

Multiple Drawing Device

Proco-Rule is the name given a five-in-one drawing device developed by Smith-Drake Corp., Inglewood, Calif. It is said to do the jobs of protractor, compass, ruler, parallels, and angles.



A set of gripping wheels is assembled in the plastic body and permits the rule to roll, but still hold exact alignment. This feature, plus accurate dimensions on all four sides, as well as the template arrangement, permits drawing of circles, parallel lines, and angles with ease and dispatch.

More information? Circle Item 82, postcard, last page.

High-Efficiency Air Filter

A new line of filters, with an efficiency of 95% on 0.3 micron particles and of 99% by the discoloration test using atmospheric dust, is announced by Cambridge Filter Corp., Syracuse, N.Y. Known as the Micretain Series Absolute filter, it is reported to offer extremely high efficiency at an initial pressure drop of only 0.4 inch w.g. Service life is exceptionally long: tests to a final pressure drop of 1.0 inch w.g. using 100% outside air show a service life of at least 4000 hours without the use of prefilters.

Filter medium is encased in a sturdy chipboard frame which is self-supporting; no frames are required and, in assembling the filter bank, the filters are easily stacked, like building blocks. A glass-asbestos filter medium with sturdy Kraft separators provides a capacity of 1000 cfm in a face area of 24 x 24 inches and a filter depth of 11½ inches.

One important use of the filter is in hospital operating room supply systems where it is 97% efficient in removing nebulized staphylococcus aerosols, and essentially 100% efficient in removing bacteria attached to dust particles.

More information? Circle Item 83, postcard, last page.

Light-Wall Stainless Fittings

Tube Turns Div., Chemetron Corp., Louisville, Ky., has introduced a line of light-wall stainless steel fittings and flanges designed for nominal-temperature, low-pressure, non-critical process piping. The line, called Pipe-Mate, will be stocked in ½ through 4-inch sizes, Schedule 5S and 10S, in the stainless steels grades best suited to corrosive applications in the large middleground area of roughly 150 psi or less, the company reports.

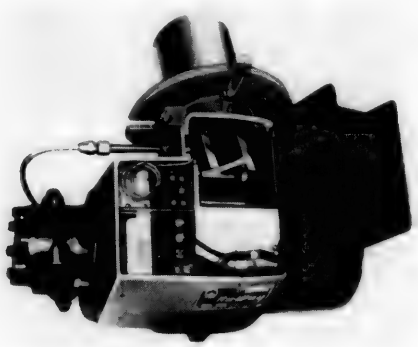
In addition to providing lower-cost fittings for non-critical applications, the line features long tangents that permit easy alignment of fittings and pipe and allow clearance for fabrication of completely flanged elbows, returns, tees and crosses.

Line includes a novel swivel-type insert flange especially designed for ease of alignment. It is a carbon steel flange, and it has a stainless steel insert at the bore, as illustrated, into which pipe or fitting can be expanded; then the carbon steel portion is simply rotated to line up the bolt holes and tightened. No welding is involved.

More information? Circle Item 84, postcard, last page.

Integrated Oil Burner

A completely integrated oil burner designed for use in OEM's residential furnace or boiler packages is announced by The Nu-Way Corp., Rock Island, Ill. The Model FC, firing 0.50 to 4.50 gph, can be completely factory-wired because primary safety relay and flame detector are in the burner, the manufacturer states.



The following advantages are claimed as a result of complete integration of components in the burner: (1) simplified wiring if the burner is installed in the plant or the field; (2) faster response to burner ignition and flame failure; (3) greater safety through elimination of remote stack element and integration of primary safety relay and flame detector in the burner. Unit can be tailored to the specific firing and performance requirements of OEM's package design.

More information? Circle Item 85, postcard, last page.

Improved Flow Indicator

An improved hydronic device for indicating the flow of water in gpm through a hot water heating or air conditioning installation has been developed by Bell & Gossett Co., Morton Grove, Ill.

Called the Thermoflo indicator, the device is said to be quiet in operation. It contains no moving parts that can vibrate. Additional advantages of the indicator include a low pressure drop and an easy-to-read scale.

The indicator is also easy to install. Two soldered connections and a square-head cock are all that is needed. Its versatile mounting, plus a scale and housing that adjust to 90-degree intervals, makes it possble to install the indicator practically anywhere, and in either a vertical or horizental position.

Device is particularly suited for determining flow rates of pumps having a flat capacity curve. It also may be used to indicate rates of flow through cooling towers, swimming pools, and heat exchanger equipment.

More information? Circle Item 86, postcard, last page.

Dry Lubrication Process

A new process for coating water mixing valves and other allied equipment with a permanent, corrosion-resistant dry lubricant is announced by Fairchild Camera and Instrument Corp., Syosset, L.I., N.Y.

The lubricant, called Life Lube, works well under the varying water conditions found throughout the United States, and has excellent chemical and thermal stability, the firm reports. It is also suited for fast moving mechanisms where wet lubricants are not desirable.

Coating is approximately .0001 to .0002 inches thick, and is permanently bonded to the metal surface giving it excellent wearing qualities. In valve construction, cheaper metals can be coated with the lubricant and substituted for more expensive metals.

Lubricant has proved very successful for the coating of moving valve parts, and several companies are presently testing the lubricant under various experimental programs. Another application includes coating gas control valves to prevent seizing and galling.

More information? Circle Item 87, postcard, last page.

New Chemical Surface Protector

Available for commercial use in the United States is a family of chemical compounds said to exhibit the ultimate in anti-corrosion and surface sealing properties. According to Coroshield Co., Ltd., New York, N. Y., it comes in a variety of formulas to solve any surface protection problem.

Binding themselves to every kind of surface, each compound forms a tenacious, inorganic, impervious, microthin film that is fire-resistant, defies chipping, peeling, flaking, and abrasion, the company states. Surface is said to be an absolute defense against oxidation agents of every degree, including hydrochloric, nitric, and sulphuric acids.

Compounds come in liquid form and are applied by spraying, brushing, dipping, filling, rolling, or by any conventional lacquer applicators. Its use in some instances permits the substitution of less durable, but less expensive, metal sheeting. Also, its use as a paint in some cases may eliminate the necessity of baking. Films can withstand a permanent load of 12 atmospheres and a constant temperature of 400 deg F.

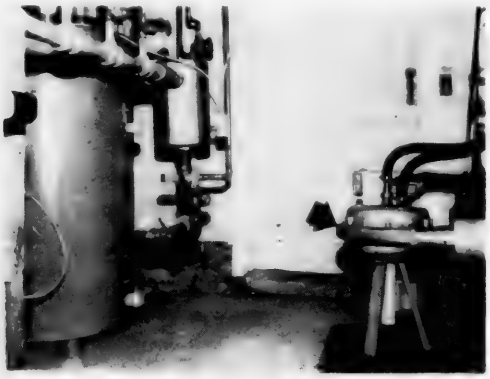
The products and their uses are as follows: Integrat, a universal sealer for almost any surface; Interlex, for the shipping industries; Portalit, for masonry; Portaplex, for the construction industry; Terralin, for underground piping; Metalspachtel, a metal filler; and Korroplast, for use over corroded areas.

More information? Circle Item 88, postcard, last page.

New Type Boiler

A new type of package boiler, whose weight and volume are one-sixth that of an equivalent conventional unit, is available from Turb-O-Heat, Inc., Brooklyn, N.Y. It is said to deliver continuous quantities of 100-psig steam within 15 sec, starting with cold tap water.

Design of the generator is based on a fin-and-tube heat exchanger section rotating at 3600 rpm within the casing. Centrifugal force on the fluid in the tubes promotes a rapid flow through the tubes, resulting in a rate of heat transfer better than 300,000 Btu per hr, the company states.



Centrifugal force is said to cause vapor disengagement at the liquid surface rather than at the tube wall and so prevent scale build-up and fouling of tubes. Furthermore, the generator acts as a pump on both the liquid in the tube and the hot gases in the shell. Higher than usual exhaust gas speeds permit use of a 4-inch pipe where a 10-inch vent would normally be required.

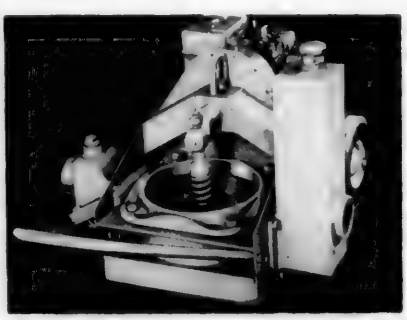
Because of its compact size, 20 by 20 by 30 inches high, the generator finds application where space is at a premium, or where fast response is important. (In photo, arrow points to 10-hp, 150-lb, generator. At left is conventional boiler of equal capacity.) It is said to have many uses in chemical processing, metal finishing ovens, space heating, garment making or cleaning, or any industry requiring a steady source of heat or steam. Either oil or gas-fired, the generator may also be used to circulate and heat the water in swimming pools; to keep railroad and bus Diesel engines warm for easy, next-day starting; or as a unit heater for railway cars.

In addition to fluid heating, the generator may also be used for cooling, vapor generation, or condensation, depending on connection of inlets and exhausts, and on supply of fuel or refrigerant in the shell. The generator can be wall or floor-mounted, or attached directly to process apparatus.

More information? Circle Item 89, postcard, last page.

Diaphragm Pump Line

A redesigned and expanded line of diaphragm pumps in the 1½ to 4-inch size range is announced by Barnes Manufacturing Co., Mansfield, Ohio. The line offers capacities from 3500 to 6000 gph at 5-ft lifts, according to a company spokesman. With the variety of sizes, power drive options and capacities available in the line, these pumps will handle almost all seepage and dewatering applications while offering convenience and economy features of compact, lightweight pumps.



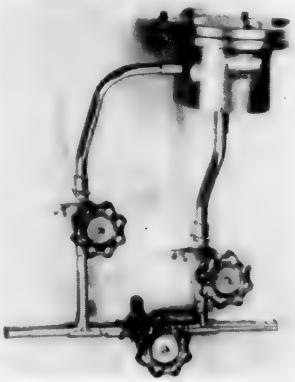
All models are available on wheels or skids with a variety of options for gasoline or electric power or universal models furnished without power to utilize gasoline engines or electric motors presently owned by customers. Standard models in the line are available in a new 1½-inch size, 2-inch, 3-inch and 4-inch models.

Other additions to the line are the Variable Power models which permit operation with 1750 or 2400 rpm power sources. A double gear reduction feature allows the customer to select the model suitable to power he presently owns.

More information? Circle Item 90, postcard, last page.

Filter-Drier Bypass Assembly

Remco, Inc., Zelienople, Pa., announces a new filter-drier bypass assembly for use by air conditioning and refrigeration contractors and dealers.



The assembly, as illustrated, provides as a compact system a Remco replaceable cartridge type filter-drier, piping, and valves which permit replacement of the molecular sieve cartridge without shutting down the refrigerant system.

Assembly uses a molecular sieve desiccant combined with massive depth filtration. Major advantage of this factory-assembled bypass system is uniform quality. Cost is actually less in many instances than the time required to make such an assembly on the job.

Each assembly includes a bracket so that the whole assembly can mount flush on a panel. The top flange may be removed without demounting the drier, since the bracket provides adequate clearance.

More information? Circle Item 91, postcard, last page.

Noise Survey Meter

A palm-sized noise survey meter to monitor and measure noise hazards has been developed by Mine Safety Appliances Co., Pittsburgh, Pa. Weighing only 12 ounces and not much larger than an electric shaver, the instrument is housed in plastic with a leather, zippered carrying case and neck cord.

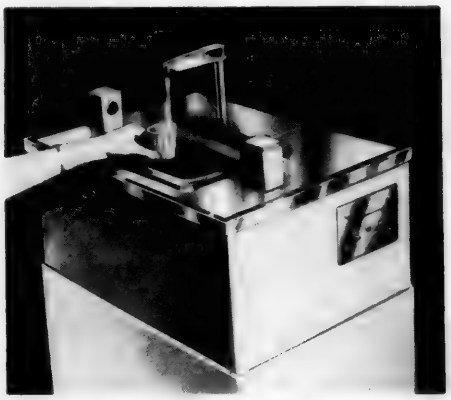
Meter is designed for rapid multi-location measurement of sound levels to establish noise-contour "maps" in large industrial plants. Company also describes the meter as an especially convenient tool for acoustical design specialists.

Complete noise analysis can be achieved when the noise survey meter is used in conjunction with the company's Soundscope, a precision instrument which can accurately measure the energy distribution of sound within a narrow frequency band. The meter can be used either ahead of the Soundscope, as a means of locating areas requiring detailed study, or behind the Soundscope, as a monitor of noise levels in areas where frequency characteristics already have been determined.

More information? Circle Item 92, postcard, last page.

Photoelectric Water Stations

Photoelectric water stations, called Electro-Fill, are available from T & S Brass & Bronze Works, Inc., Westbury, L.I., N.Y. The act of placing a glass or paper cup under the water spout breaks a beam of light; water flows instantly to fill the vessel. Withdrawal of glass provides instant, positive shut-off of water flow.



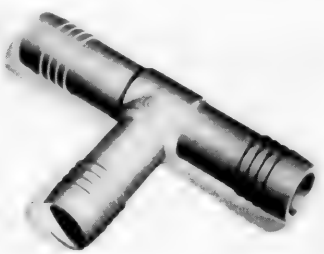
These water stations, available in console models and deck or wall types, are said to provide a new standard of efficiency for serving water in any type of restaurant. They are described as unsurpassed for sanitation, speed, economy, and trouble-free performance.

Console models are available with or without ice storage chest. They are furnished with 1/3-hp hermetic compressor with valves, ready for plug-in operation. Instantaneous cooler is rated at 15 gph.

More information? Circle Item 93, postcard, last page.

Polypropylene Insert Fittings

Plastics Div., The Union Malleable Mfg. Co., Ashland, Ohio, announces a new line of insert fittings. The fittings, known as Poly-Plus Blue and made of Hercules Profax (polypropylene), can be used for all flexible pipe applications.



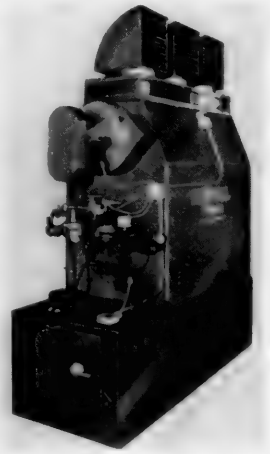
These insert fittings are designed to give added durability and flowability, and because of high impact strength, the fittings will withstand breakage or splintering and will outlast the life of the pipe, the company reports.

The fittings, consisting of couplings, tees, ells and adapters, range in size from 1/2 to 2 inches.

More information? Circle Item 94, postcard, last page.

Dual-Fuel-Fired Space Heaters

A draft-induced, combination fuel burner is featured in a line of space heaters manufactured by National Heater Co., Inc., St. Paul. Minn.



Burner is designed specifically for the company's National Champion Model CI and is said to provide greater efficiency and reduced maintenance. It burns gas, oil or combination gas and oil fuels.

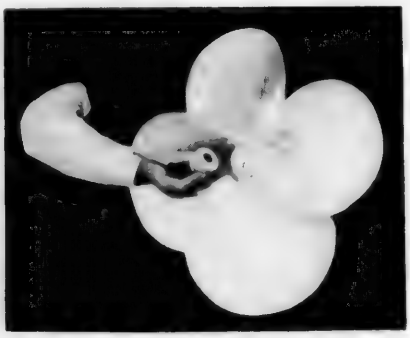
Available in 14 sizes ranging from 400,000 to 3,500,000 Btu, the space heaters have belt-driven exhausters for maximum draft adjustment, standardized controls and circuits, and a separate motor compartment to facilitate lubrication and adjustment. Heat and corrosion resistant metals are used throughout the heat exchanger unit.

Streamlined blower assemblies and larger wheels and scrolls deliver greater air volume while high velocity discharge louvers and large floor return louvers give more efficient warm air distribution, the company states. As an added safety precaution, controls are recessed and provided with a circuit breaker door lock.

More information? Circle Item 95, postcard, last page.

Interchangeable-Hub Fan Blades

An improved line of interchangeable-hub fan blades is announced by Ventco, Inc., Houston, Tex. With this Adapter series, a wholesaler or manufacturer using fan blades of different specifications can reduce his blade stock as much as 75%. He can assemble any size or style of propeller from a small stock of component blades and interchangeable reversible hubs.



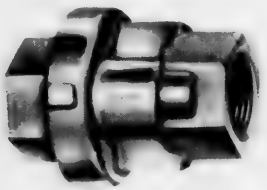
All the blades have uniform size openings. Any bore hub can be quickly assembled into any blade by simply driving three screws. This gives a firm, positive, durable lock. The propeller thus produced meets all standards of quality, efficiency, and economy, the company reports.

Blades are available in six sizes from 10 to 24 inches, in both 3-blade and 4-blade styles, clockwise and counterclockwise, and in various degrees of pitch. The interchangeable hubs come in six bore sizes ranging from ¼ to ¾ inches in bore.

More information? Circle Item 96, postcard, last page.

Flow Regulating Device

This flow regulating device, from Automatic Controls Div., Hays Manufacturing Co., Erie, Pa., automatically permits a specified rate of flow regardless of inlet pressures. The manufacturer claims low pressure drop because of its unusual design. For hot or cold water, it is available in 49 flow rates from 0.2 to 50 gpm. Flow



tolerances are maintained to 180 psi and temperatures to 160 deg F. Device, known as L-P-D Measurflo, operates noiselessly at any pressure, the company states. It is seen having wide use in industry such as (1) time-fill applications, (2) water conservation requirements, (3) stream regulation, (4) balanced flow systems, and (5) specific flows to a variety of units from one source of supply.

More information? Circle Item 97, postcard, last page.

Pipelines Lined in Place

Concrete and metal pipelines can now be reconditioned in place by lining with acid-resisting epoxy resin, according to Centriline Corp., New York, N. Y., a subsidiary of Raymond International Inc.

The company has developed the lining for pipelines that are subjected to excessive acid attack, such as sewer and industrial waste lines. Pre-mixed epoxy resin is applied with machines that travel through pipes from 24 to 144 inches in diameter. These machines apply lining material by centrifugal force from a high-speed revolving head, then smooth the lining with automatic trowels.

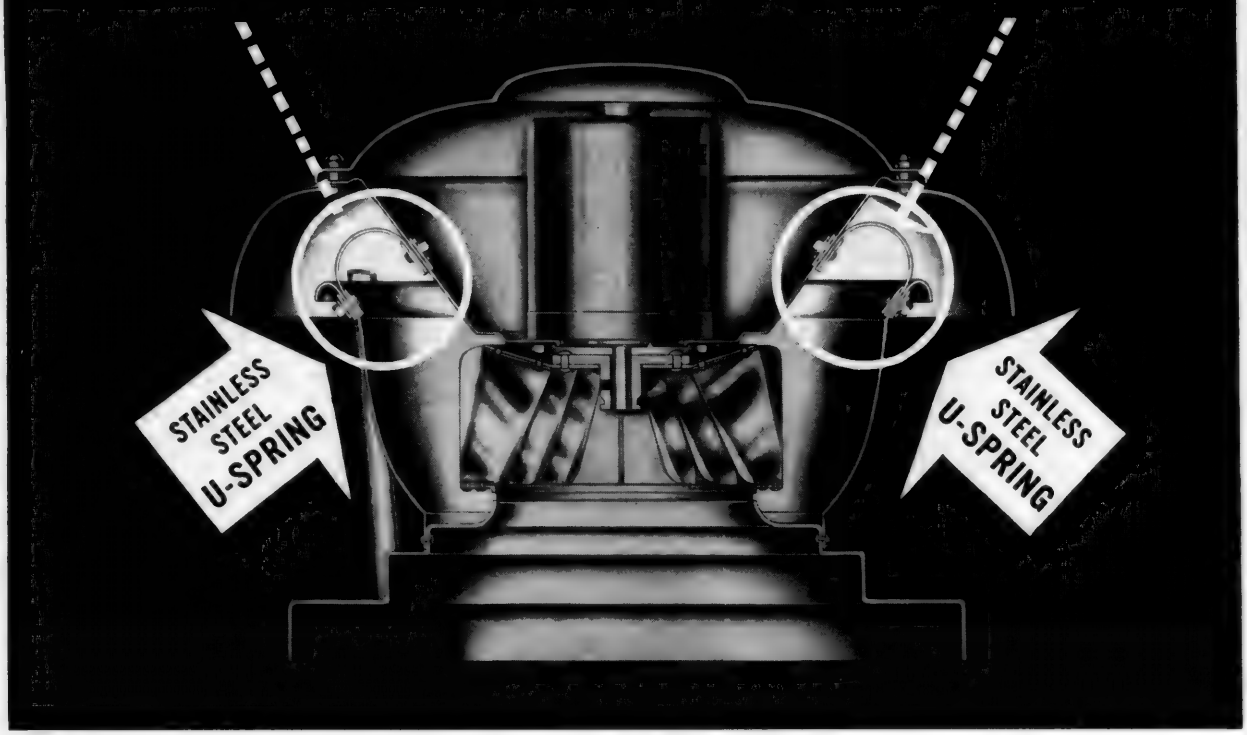
A variety of epoxy resin linings with a minimum thickness of ⅛ inch can be placed in a single pass. Linings consist of pure resins extended and pre-mixed with inert filler materials.

Epoxy resin is said to provide a tight bond with pipe materials. Variation of extended ratios can produce a wide range of compressive and tensile results. Most common ratios produce compressive strengths of more than 7,000 psi, and tensile strengths of more than 1,500 psi.

More information? Circle Item 98, postcard, last page.

(Continued on page 132)

GUARANTEED FOR LIFE!



Stainless steel U-spring noise and vibration isolators . . . a Jenn-Air exclusive!

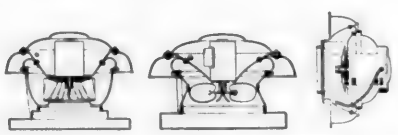
Most power exhausters depend on rubber isolators to dampen noise and vibration. Rubber does a reasonably good job when new, but it cannot withstand the ravages of heat, moisture and oil. Eventually, like the tires on your car, rubber isolators break down, leaving you with expensive repair bills or the need for complete exhauster replacement.

Dissatisfied with the impermanent nature of rubber, Jenn-Air engineers set out to develop a vibration isolator that would not break down. What they perfected was a unique power assembly suspension system built around stainless steel U-springs. Three to five U-springs are now used in each direct driven Jenn-Air Exhauster. They eliminate noise by isolating both radial and lateral vibration . . . and they're *guaranteed for life.*

In addition to providing lifetime service, Jenn-Air U-springs absorb 44% more vibration than rubber isolators. This fact was proved conclusively in independent tests conducted by the Pittsburgh Testing Laboratory.

Effective elimination of vibration is the key to quiet operation and long exhauster life, and Jenn-Air does this job better than any exhauster made! Jenn-Air's complete line of spun aluminum exhausters for roof and wall installation is covered in Bulletin 58-B . . . write for your copy today.

First Name in Power Exhausters



JENN-AIR

Jenn-Air Products Co., Inc. • 1102 Stadium Drive, Indianapolis 7, Ind.

ACTUAL AIR DELIVERY

with Alnor® VELOMETER

A simple, direct reading on the Alnor Velometer gives you instant measurement of actual air delivery in any distribution system. This fast, precise method eliminates the time and money wasted in trial-and-error balancing...the profit-eating call-backs so often necessary with other less precise measurements.

The Velometer is the only instantaneous, direct reading air velocity meter—accurate in all ranges, from high to low... compact, portable, easy to understand and use. Wide assortment of jets and fittings makes this precision instrument ideally suited for all air velocity measurement.

First Choice of Industry

Take the recommendation of every major manufacturer of air diffusers and leading contractors—get an Alnor Velometer. You'll save time and money on the next installation you balance.

Alnor

PRECISION INSTRUMENTS FOR EVERY INDUSTRY

Illinois Testing Laboratories, Inc.
Room 514, 420 N. LaSalle St.
Chicago 10, Ill.

Please send Velometer Bulletin 2448-G.

Name.....

Company.....

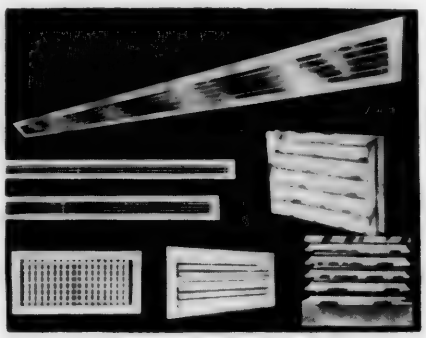
Address.....

City.....**Zone**.....**State**.....

(Continued from page 130)

Aluminum Air Diffusing Grilles

Its Eagle line of air diffusing grilles includes units in over 30 different louver designs and over 24 different border designs, according to Titus Mfg. Co., Waterloo, Iowa. They are completely designed, manufactured, and tested by the company.



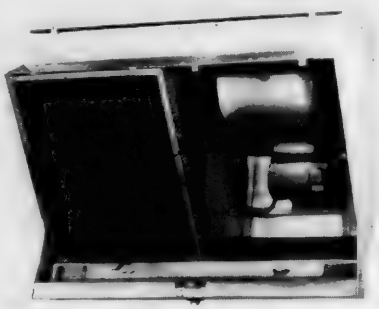
Some of the grilles in the new line are as illustrated: At top of photo, Slim Line grilles; Left center, Linear type; Right center, outside louvers and penthouse; Bottom left, sidewall supply grilles and registers; Bottom center, Series 200 ceiling and sidewall grilles.

More information? Circle Item 99, postcard, last page.

Range Venting System

A range venting system that requires no roof fan installation is announced by Morrison Products, Inc., Cleveland, Ohio. Called Filtaire, it is a self-contained unit, complete with blower and motor.

Designed for restaurants and other mass feeding establishments, the system eliminates smoke, heat and odors



by blower pressure directly over the range. Thus, operating costs are lower than with roof fan systems, where stack leaks may cause air losses of as much as 35%, the company states.

Advantages include ease of installation, ease of servicing, and ease of removal. System is available in single, double and triple filter units in capacities of 1000, 2000 and 3000 cfm.

More information? Circle Item 100, postcard, last page.

(Continued on page 134)

Capitol Architect, J. George Stewart
Mechanical Contractor, Lloyd E. Mitchell, Inc., Baltimore
Consulting Engineer, Guy B. Panero, New York

Photo by Henry Rohlund,
Staff Photographer,
Washington Post & Times Herald

RIC-WIL underground piping... ..."GOES TO WASHINGTON!"

The photograph shows the dismantling of the east front of the Capitol Building. The extension of the Capitol Building will be completed in 1960 and some 32 feet will be added to the over-all structure. The photograph also shows a section of new RIC-WIL pipe (foreground) that will handle the steam service.

For over 48 years RIC-WIL has supplied piping distribution systems for institutions of all types, industrial plants in every facet of industry and community central heating. These systems are proven by over *eight million* lineal feet of installations... Write, wire or phone for literature on the many types of systems available.

See our catalog in Sweets

Quality Piping Systems...
...of Exceptionally High Thermal Efficiency

SINCE 1910

RIC-WIL INCORPORATED — PREFABRICATED INSULATED PIPING SYSTEMS

BARBERTON, OHIO

IN CANADA: THE RIC-WIL COMPANY OF CANADA LIMITED

(Continued from page 132)

Curb Base for Roof Ventilators

A prefabricated curb base for roof ventilators, available with automatic or motor-operated louvers, if desired, is offered by Loren Cook Co., Berea, Ohio. It can be used on new or old construction.

Model VC curb base fits into a framed roof opening, and is fastened by nailing, bolting or welding to the deck. No other construction is necessary. The ventilator fits over

the curb and fastens to the wood top frame. An extended collar at the bottom of the curb houses the louvers.

Curb is made of heavy-gage steel with insulated double walls. A built-in "cant strip" lends itself to all types of roofing construction. Roofing paper can be rolled up the sides of the curb, eliminating hollow spots.

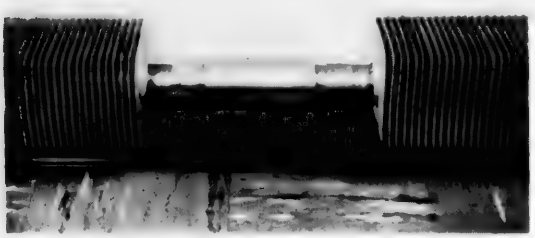
The curb is available in 12 sizes for use with the company's ventilators ranging from 16 to 48 inches. Curbs will fit many ventilators made by other manufacturers.

More information? Circle Item 101, postcard, last page.

Sweat Fitting Expansion Joints

A line of copper sweat fitting expansion joints is introduced by Rotherm Engineering Co., Inc., Chicago, Ill.

Joints, which dampen pipe noises, are recommended for hot water heating and refrigeration applications. They



have a temperature range from minus 30 to plus 240 deg F, and have a full 2 inches of axial expansion with full 360 degree rotation.

Seal is a spring seated Buna wedge seal or a copper ball seat, permitting flexibility for alignment. All parts are non-corrosive. Sizes range from ¾ to 2-inch copper tube connections.

More information? Circle Item 102, postcard, last page.

(Continued on page 138)

YOUR IDEAS WORK BETTER WHEN YOU WORK WITH HONEYWELL

THE FOLLOWING pages bring you some of the latest developments in automatic controls from Honeywell. They widen your choice of products; give you more to work with.

For complete information on these new control products and systems, call your nearest Honeywell sales office. Honeywell provides 112 sales offices throughout the country. Each is staffed with control specialists to assist you in writing specifications and preparing control layouts.

Honeywell's new Selectographic DataCenter* features modular design!

It simplifies application, adds new economy to centralized control!

THE HONEYWELL DataCenter lets one man do the work of a crew—set temperatures, make adjustments, supervise critical areas of an entire building's air conditioning system from one central location.

And Honeywell's modular building block design gives greater economy, new flexibility. Starting with the basic unit—the central Selectographic Console—modules of a standard 2′ by 2′ dimension may be added as the need arises or as budget permits. Honeywell's Selectographic DataCenter can be installed in buildings of all sizes, for all purposes; can grow with your needs.

For more information about this panel, call your local Honeywell office. Or write Honeywell, Dept. HV-6-92, Minneapolis 8, Minnesota.

*Trademark

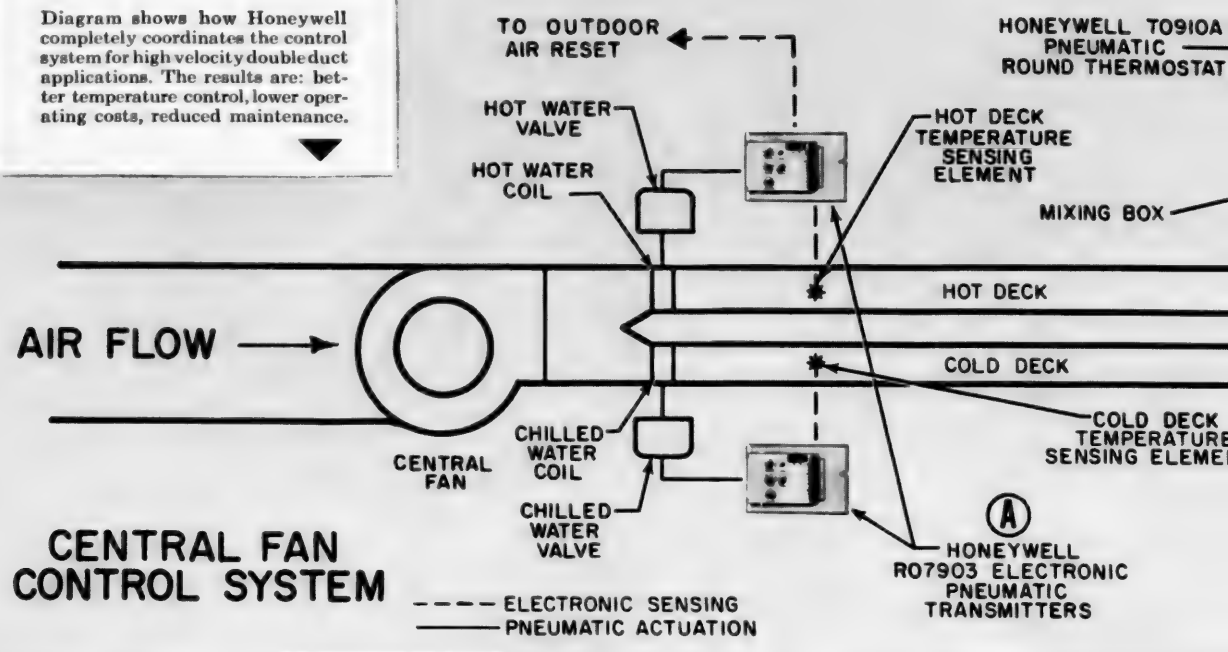
FOR MORE TO WORK WITH WORK WITH HONEYWELL

Honeywell

H HONEYWELL First in Control

Now a coordinated high velocity double

Diagram shows how Honeywell completely coordinates the control system for high velocity double duct applications. The results are: better temperature control, lower operating costs, reduced maintenance.



A

HEART OF THE SYSTEM: New Honeywell RO7903 Transistorized Electronic-Pneumatic transmitter combines the advantages of Electronic Sensing with PNEUMATIC Actuation

Adjustment for throttling range
Adjustment for second thermostat effect
Adjustment for outdoor-air thermostat effect
Adjustment for calibration and control point

Now all setting adjustments for a master-submaster system can be made at one central location—scientifically and precisely. Difficult, inexact on-the-spot adjustments at sensor locations, thermostats and elements can be eliminated. There's a free choice of sensor locations because they no longer need be accessible for system adjustment.

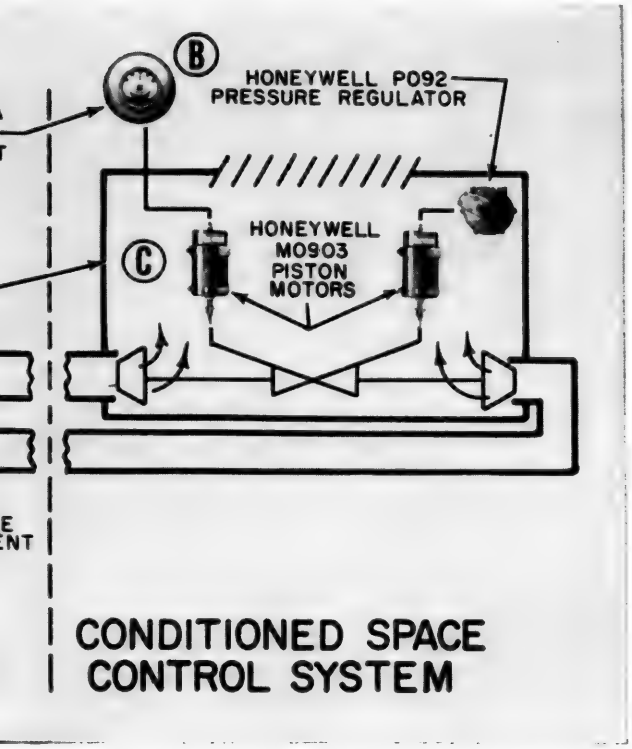
This new relay combines the sensitivity, freedom from ambient temperature effect, fast response and versatility of *electronic sensing*, with the powerful, rugged economy of *pneumatic actuation*. It provides an easier way to do a better job.

Honeywell's new electronic-pneumatic transmitter comes with a choice of specialized sensing elements, costs little more than old-fashioned master-submaster control systems, saves on installation and operating costs. For more information about its many applications, call your nearest Honeywell office.

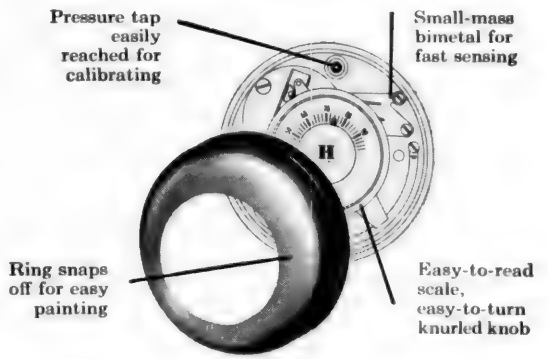
SMITH®

News of Equipment and Materials

e duct pneumatic control system!



B The Honeywell Pneumatic Round for ideal room temperature control

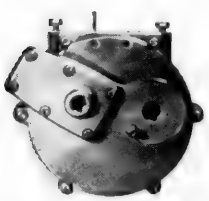

Pressure tap easily reached for calibrating
Small-mass bimetal for fast sensing
Ring snaps off for easy painting
Easy-to-read scale, easy-to-turn knurled knob

To assure close temperature control in the conditioned space, specify the famous Honeywell Pneumatic Round Thermostat. The fastest responding pneumatic thermostat on the market, it is also the most accurate. Simplified design and a complete line of fittings make it easy to install and maintain. New rugged stainless steel tamper-proof cover is available.

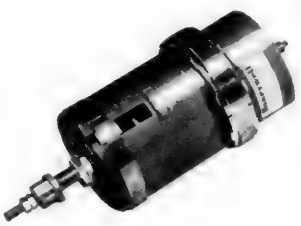
C For economical mixing box control choose the Honeywell Volumatic* system

Honeywell's Volumatic* system provides dependable, economical volume control of double-duct systems. It uses the new M0903 piston motor with nylon bearings which require less lubrication. And its sensitive P092 Pressure Regulator provides accurate control of volume.

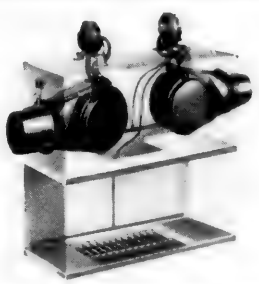
The new Honeywell Volumatic system is adaptable to mixing boxes of any size, made by any manufacturer, and can be used with many types of linkages.



Volumatic's P092 Pressure Regulator: large diaphragm area provides maximum sensitivity and speed of response; metal to metal flapper and nozzle give long, service-free life; snap-on rubber hosing and fixed restriction make installation easy.



Volumatic's M0903 Piston Motor regulates air mixture valves smoothly and accurately, gives smooth modulation. All exposed parts are treated for moisture resistance. Large diameter nylon bearing provides better service with less lubrication.



For the finest mixing box performance choose the Honeywell Duablend* system

Honeywell's Duablend* system gives the finest mixing box performance available anywhere. Superb performance is secured by using *two* pressure regulators to assure constant volume from each duct (under control of space thermostat) regardless of pressure changes. Exclusive Sub-master pressure regulator provides a similar stabilizing control action to the Sub-master duct thermostat in heating and ventilating units.

*Trademark

SMITH®
HYDRO trol
HYDROSTATIC SHOCK CONTROL

CONTROLS
HYDROSTATIC
SHOCK

CONTROLS PRESSURE WITH PRESSURE

Hydro-Trol's Pressurized Design using Pneumatic and Hydraulic Pressure to control Hydrostatic Pressure . . . provides a more effective and efficient way to control Hydrostatic Shock and eliminate water hammer in any hot or cold water piping system.

PRESSURIZED DESIGN

STOPS
PIPING
KNOCK

NITROGEN PRESSURIZED COMPRESSION CHAMBER
Controls bellows expansion under normal water line pressure so that full expansion capacity is available to control shock

HYDRAULIC FLUID

STAINLESS STEEL BELLOWS

IN LINE DESIGN
Direct Action Type Bellows respond instantly to control shock pressures.

PNEUMATIC PRESSURE
As shock occurs, bellows expand creating a pneumatic pressure cushion which absorbs and controls shock

HYDRAULIC PRESSURE
Controls bellows alignment and cushions bellows contraction to control shock wave bounce.

BALANCED BELLOWS
Constructed to insure each convolution expanding evenly and equally providing maximum displacement for dissipating shock pressures into pneumatic cushion

Built to withstand and control the extreme pressures of Hydrostatic Shock, the bellows are pneumatically and hydraulically controlled and cushioned against metal to metal contact, shock, stress, or strain . . . ever causing metal fatigue and bellows failure.

Using no rubber or synthetic compressables, Hydro-Trol's all stainless steel internal construction is unaffected by temperatures and time. Factory sealed, and permanently pressurized, Hydro-Trol more efficiently and effectively controls Hydrostatic Shock and may be counted upon to last the "Life of the Piping System."

SIX SIZES
Meets the requirements of every hot or cold water distribution system.

COMPACT IN SIZE
Installs in small pipe chase spaces.

LIGHTER IN WEIGHT
Requires no supporting devices.

SIMPLIFIED SIZING
Hydro-Trol makes sizing simple and easy.

JAY R. SMITH MFG. CO.
Union, New Jersey
PLUMB-EASY

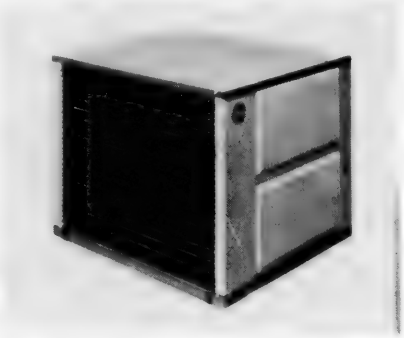
FOR FURTHER INFORMATION WRITE FOR YOUR COPY OF "SHOCK CONTOL BY HYDRO-TROL"

(Concluded from page 134)

Split-System Heat Pump

Announcement of a new split-system Weathertron heat pump is made by General Electric Co., Tyler, Tex. The system consists of an attractive, weather-resistant remote outdoor unit, and an air handling unit.

The compact air handler is no larger than many room coolers, the manufacturer states, and can be mounted on the floor, on a platform, or suspended from the ceiling



with special mountings to save valuable floor space. A 3-speed blower control allows maximum versatility for airflow adjustments. Electric duct heaters are also available as an accessory to supply supplemental heat during extremely cold weather.

The outdoor remote units, illustrated, are fully factory-charged with R22, and equipped with built-in service valves to reduce installation time and costs at the job site.

This addition to the company's line is available in 2½- and 3-ton sizes.

More information? Circle Item 103, postcard, last page.

Self-Contained Conditioner

Illustrated is Model SCU-MH, a recent modification of the standard line of self-contained equipment manufactured by The Governair Corp., Oklahoma City, Okla.

Unit features 10 and 15 ton hermetic compressors, in the multiples required to furnish capacities ranging from 10 to 75 tons.

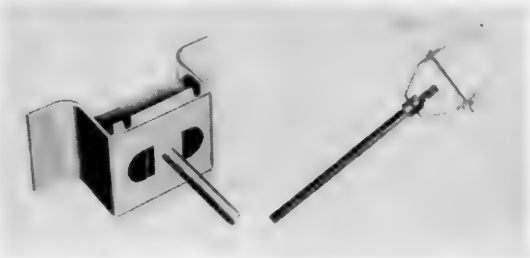
Capacity reduction is accomplished by multiple circuits and/or by use of back pressure regulative valves.

More information? Circle Item 104, postcard, last page.

BRIEFLY STATED

Pipe Suspension Hanger, Insert

Two new light-duty economy products have been added to the pipe suspension line manufactured by Fee & Mason Manufacturing Co., Inc., Manasquan, N.J.



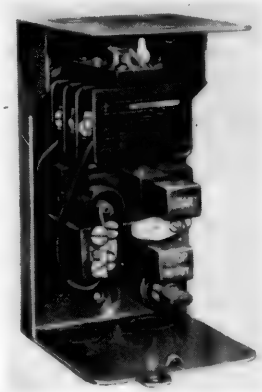
(1) A light-duty universal concrete insert, designed to ease installation problems through notched nailing flanges and a "knock-out" plate; and

(2) A light-duty clevis hanger for low-cost installation in residential units, light industrial plants, commercial establishments, air-conditioning units and gas, water, steam and air lines.

More information? Circle Item 105, postcard, last page.

New Manual Starters

An advanced design manual starter, rated through 7½ hp, 440-550 volts a-c and 2 hp, 230 volts d-c, incorporates many new features, according to the manufacturer, Furnas Electric Co., Batavia, Ill.



Two moving parts replace complex mechanical linkages in the push-button mechanism and insure longer life. Also, a direct mechanical-acting thermal overload operates independently of the second overload or push button mechanism. This "trip-free" overload unit makes it impossible for the operator to hold the circuit closed against overload.

An optional feature for this manual starter is a "jog-run" accessory for precise positioning on a-c applications. When in the "jog" position, it allows contact-make only while the starting button is held in the depressed position. Accessory can be factory or field installed.

More information? Circle Item 106, postcard, last page.

Gas Water Heating

The figures in the body of Table 3 of the Reference Section, Water Heating for Commercial Kitchens, in the May issue of this publication were incorrectly indicated as Gas Input Required, Btu per Hour. The heading should have read Thousands of Btu per Hour.

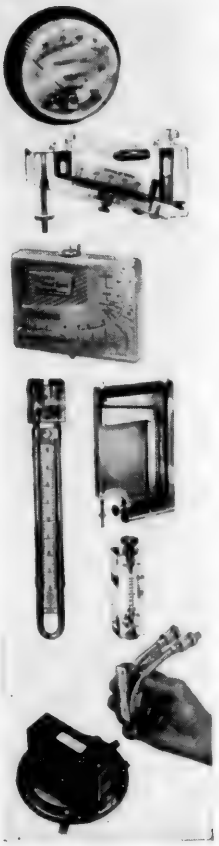
NEW GAGES NEW IDEAS

IN THE 1959

Dwyer

INSTRUMENT MANUAL

Need a meter for *direct* reading of both air velocity and static pressure? An inexpensive gage that tells homeowners when to change air filters? A complete, accurate combustion test kit, or a manometer that *rolls* up to fit compactly in your tool box? You'll find these and many more money-saving ideas described in this free Dwyer manual. It's packed full of valuable information about Dwyer's complete line of instruments.

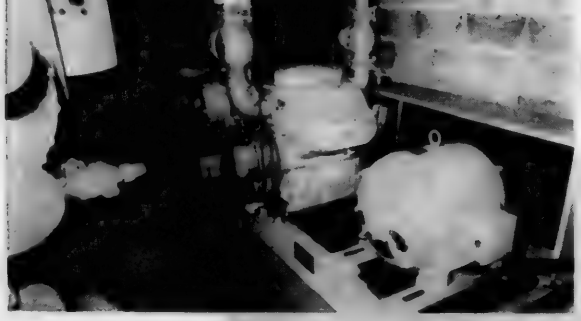


- **Magnehelic Gages** . . . velocity, resistance, draft, static and gas pressure.
- **Inclined Tube Gages** . . . draft, velocity, slight pressure variations.
- **Air Filter Gages** . . . models for every installation.
- **Hook Gages** . . . a true low pressure calibration standard.
- **Air Velocity Meters** . . . direct reading of air velocity and static pressure.
- **Flowmeters** . . flow measurement of gas
- **Wind Speed Indicators**
- **Slack-Tube Manometers** . . . roll-up types.
- **Flex-Tube Manometers** . . . U-tube, well types.
- **Inclined-Vertical Manometers**
- **Combustion Test Kit** . . . for CO_2 content, draft, temperature, smoke.
- **Pitot Tubes** . . . inch-graduated, stainless steel.
- **Pressure-Actuated Switches**
- **Special Instruments, Designs**

Send for your free copy today

F. W. DWYER MFG. CO.

P. O. BOX 373-N • MICHIGAN CITY, INDIANA



Beautiful Doctors Motel
St. Petersburg, Florida.

▽

△

View of Vilter compressors that provide the refrigeration for the air conditioning system.

Comfortably Cool in a Warm Sunny Clime

Comfortably cool year 'round . . . inside, that is, at Doctors Motel, St. Petersburg, Florida. Dependable Vilter air conditioning is the answer.

There are 100 motel units at Doctors Motel and all are Vilter air conditioned. The system has a total capacity of 100 tons and is designed to keep the rooms at 78° F. and 50% relative humidity when outside temperature is 100° F. and humidity 90%.

This motel was opened to the public in December, 1956. From that time to the present *not a single adjustment has been required on the air conditioning system.* It is functioning perfectly and hasn't required any service work . . . a cost-saving installation. The owners are delighted with the performance of the Vilter system.

Vilter equipment installed at Doctors Motel includes two six-cylinder VMC Refrigerant-12 compressors; one shell and tube condenser, liquid receiver, water chiller and 100-ton heat exchanger.

Correct system layout, well-engineered equipment, careful fabrication, and floor testing of Vilter equipment pays off in efficient operation, long life and minimum maintenance. Why not call in Vilter for your refrigeration and air conditioning requirements.

Sold by Vilter Distributor, O'Dower Engineering Company, Kansas City 6, Mo.
Architects: Kivett, Myers & McCallum, Kansas City, Mo.
Mechanical Engineer: W. L. Cassell, Kansas City, Mo.

Write for this helpful bulletin to:
The Vilter Manufacturing Company, Dept. G-816
2217 S. First Street
Milwaukee 7, Wisconsin

Bulletin 820
Vilter VMC
Compressors

Vilter®
REFRIGERATION and AIR CONDITIONING

THE VILTER MANUFACTURING COMPANY, Milwaukee 7, Wisconsin
Air Units • Ammonia & Freon Compressors • Booster Compressors • Baudelot Coolers • Water & Brine Coolers • Blast Freezers • Evaporative & Shell & Tube Condensers • Pipe Coils • Valves & Fittings • Pakice & Polarflake Ice Machines

NEWS ITEMS

Malcolm G. Lowe, chief mechanical engineer for QUINTON ENGINEERS, LTD., Los Angeles, Calif., left for Europe on April 15th to attend the International Conference on Schoolhouse Heating and Air Conditioning, which was held in Paris, France, in May. He will attend the summer meeting of England's Institution of Heating and Ventilating Engineers in Edinburgh, Scotland. The Institution is the English equivalent of the American Society of Heating, Refrigerating and Air Conditioning Engineers. Mr. Lowe has planned a full schedule for his ten week trip through Europe. In addition to the two engineering conferences, he has arranged to visit and discuss with European consulting engineers the design of high temperature water heating systems, as well as inspecting actual installations in England, France, Denmark, Germany, Switzerland and Italy.

WITH THE ENGINEERS

Robert Kyle, formerly vice president and director of The Gas Machinery Company, Cleveland, Ohio, has joined COMMONWEALTH SERVICES INC. as a senior consultant. He will make his headquarters in Commonwealth's New York office at 300 Park Avenue, according to W. B. Tippy, president of the management and engineering consulting firm. . .

William H. Byrne, P.E., and associated companies, BYRNE ASSOCIATES, INC., and STEVENS AND WOOD, INC., have moved to new and larger quarters at 50 Church St., New York 7, N. Y. . . .

M. H. Cutler has been named engineering manager of STONE & WEBSTER ENGINEERING CORP., New York and Boston. Formerly assistant engineering manager, he succeeds Fred W. Argue who was recently named executive vice president. In a series of other executive

(Continued on page 142)

SAVE SPACE WITH COPPER TUBE. Anaconda copper tube and fittings assemblies are compact, result in greater ceiling height and more usable floor area. No need to build wide plumbing walls—a 3″ copper tube stack with fittings will fit inside a 4″ partition. Overhead work is easier because copper plumbing is about *one fourth* the weight of ferrous materials. In close quarters, copper makes light work out of tight work. Use these space-saving modern plumbing materials—Anaconda copper tube and solder-joint fittings—for your next water supply AND sanitary drainage installation. For more information on copper tube, write: The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ont. 5103

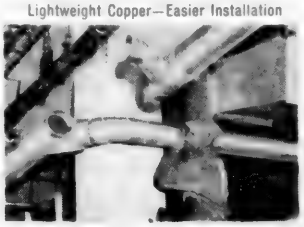
ANACONDA® **COPPER TUBE AND FITTINGS for soil, waste and vent lines**

Available through plumbing wholesalers. Products of the American Brass Company

Longer Lengths—Fewer Joints

Preassembly—Saves Time

Lightweight Copper—Easier Installation



Easier Remodeling

for FUME

CONTROL

install

FLEXAUST®

HOSE

Made of strong neoprene coated cotton or nylon fabrics spiral wire reinforced.
For *all* kinds of fume and dust control, and ventilation uses.
Extremely flexible, durable, and lightweight.
Exceptionally easy to cut, install, connect, reuse, and relocate.
Sizes 1¼" thru 36" i.d.

Write for details today
Distributors
in all principal cities

THE FLEXAUST COMPANY
Dept. HV-6
ARK AVE NEW YORK 17 N Y

Briefly Stated

(Continued from page 140)

shifts, Thomas A. Fearnside, chief mechanical engineer, was made assistant engineering manager. Floyd F. Dedrick, assistant chief mechanical engineer, was named to succeed Mr. Fearnside. . .

A new firm, IAN GRAD ASSOCIATES, CONSULTING ENGINEERS, specializing in mechanical, electrical and industrial engineering, announced the opening of offices at 114 East 32nd Street, New York 16, N. Y. Associated with the firm, is Aaron Zicherman, who, along with Ian Grad, recently resigned from Fred S. Dubin Associates. Their respective positions were New York office manager and chief engineer. The two combine thirty-five years of cumulative experience in engineering and construction in the New York City metropolitan area, gained through their prior associations with Voorhees, Walker, Smith & Smith; Jaros, Baum & Bolles; Western-Knapp Engineering; Dwight D. Kimball; Gussow & Skidmore; Eugene J. Brandt & Co.; Thermodyne Corp.; Mahoney-Troast Co., and others.

INSTITUTES AND ASSOCIATIONS

Harold L. Humes has been elected its 1959-60 president by BUILDING RESEARCH INSTITUTE, Washington, D. C. Mr. Humes, who is a vice-president and a director of Baldwin-Hill Co., Trenton, N. J., had been a BRI vice-president, member of its Board of Directors, and chairman of its key Program Committee for two years. It was under his chairmanship that the Committee was transformed from its prior status as a reviewing body to the active, operating machine it is today. Named BRI vice-president is Robert W. Cutler, general partner of Skidmore, Owings & Merrill, New York architectural firm, and Fellow of AIA. . .

Research findings on air pollution topics will be presented June 22 through 26 when Los Angeles hosts the 52nd annual meeting of the AIR POLLUTION CONTROL ASSOCIATION.

(Continued on page 144)

Super-Quiet

LENNOX

"OG" SERIES
INDUSTRIAL HEATER

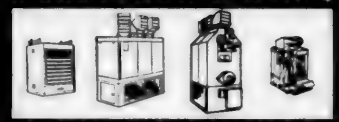
- Blower moves huge volumes of air at extremely quiet sound levels
- Rugged blower shaft design eliminates vibration problems

The "OG" blower incorporates self-aligning, permanently lubricated ball bearings. Blower motor is mounted on adjustable slide rails, and the entire section is easily accessible for service. This is just a sampling of why the "OG" is "stepping ahead" in industrial heating.

Wide Choice of Air Volume Capacities

Blower motors and drives are available to satisfy all air volume requirements up to 2 in. external static pressure.

LENNOX "Task Matched" Equipment
to control and condition air for industry



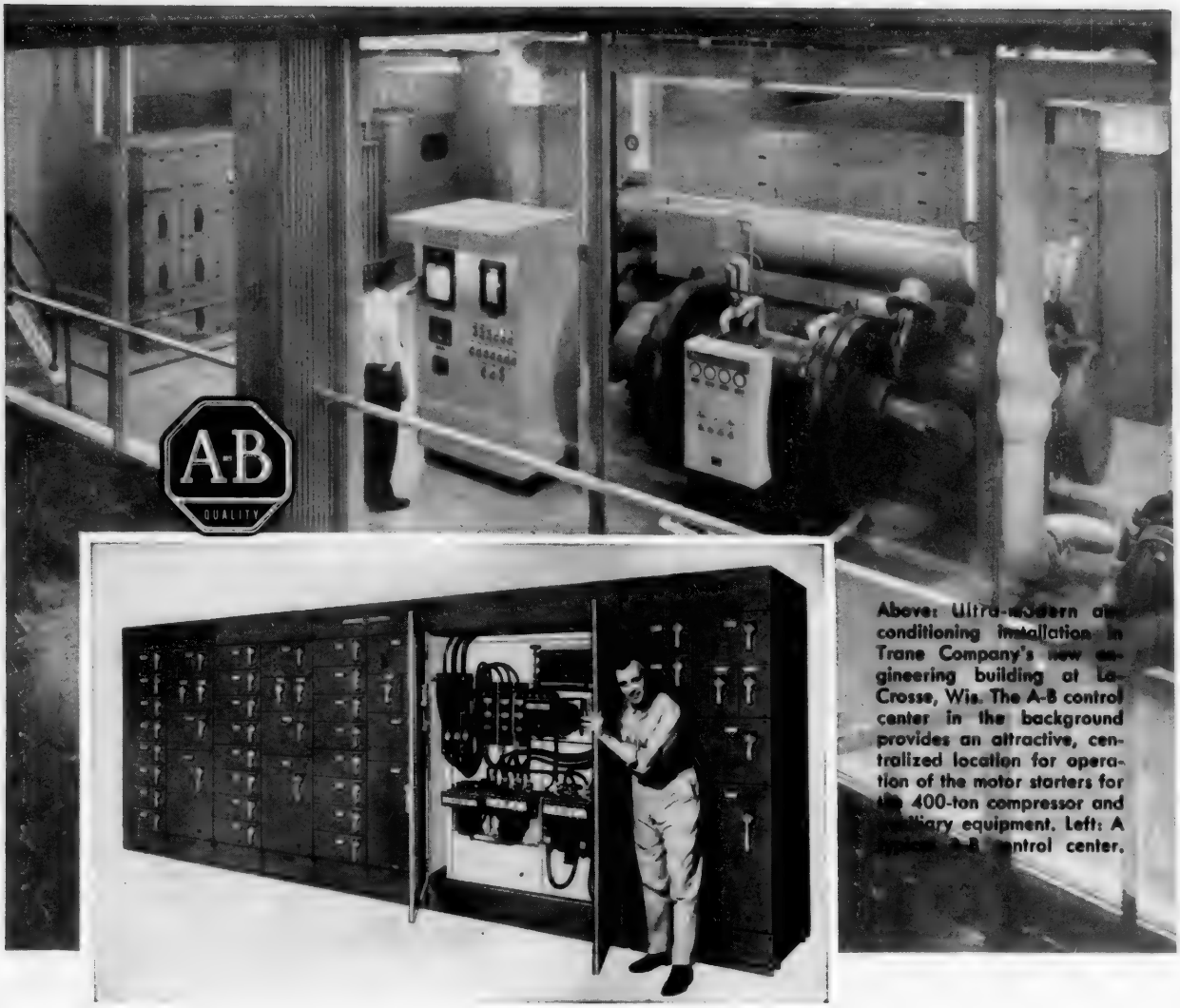
64,000 to 2,000,000 Btuh Units

CLIP AND MAIL FOR
FREE SPEC SHEETS

LENNOX Industries Inc.
INDUSTRIAL DIVISION
Box 1294, Dept. AC-6,
Des Moines 5, Ia.

Please send me—without obligation—complete specifications and engineering data on Lennox "OG" Series Industrial Heaters

Name_____
Company_____
Address_____ City_____
Title_____



Above: Ultra-modern air conditioning installation in Trane Company's new engineering building at La Crosse, Wis. The A-B control center in the background provides an attractive, centralized location for operation of the motor starters for the 400-ton compressor and auxiliary equipment. Left: A typical A-B control center.

TRANE—specialist in air conditioning . . . uses

ALLEN-BRADLEY Motor Control

for its new engineering building

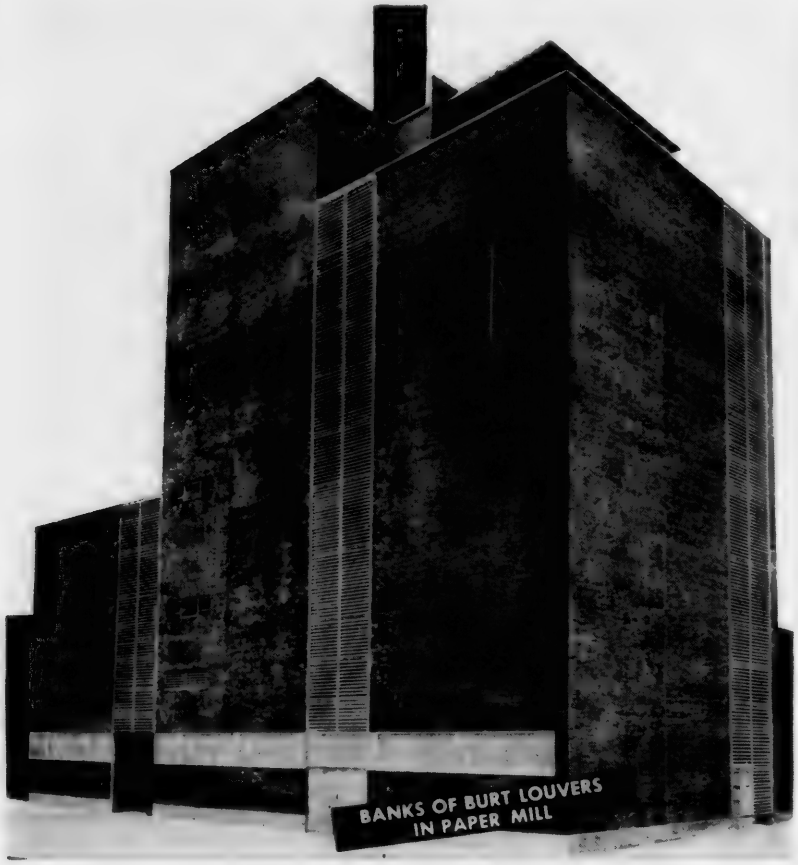
Manufacturers of electrically powered equipment are the *first* to realize how important reliable motor controls are to the performance of their installations. And to insure this desired reliability, more and more leading companies are turning to Allen-Bradley—the *quality* motor control.

The simple solenoid design—for which Allen-Bradley starters, contactors, and relays are famous—has only ONE moving part. With virtually *nothing* to go wrong, you are assured millions of trouble free operations. There are no bearings, pivots, or pins to corrode and stick . . . no flexible jumpers to wear and break.

In addition, the double break, silver alloy contacts—a standard feature throughout the Allen-Bradley line—never need service attention. They are always in perfect operating condition . . . and remain so without maintenance until completely worn away. And *all* Allen-Bradley starters are equipped with two reliable and permanently accurate thermal overload relays to protect motors against "burnouts."

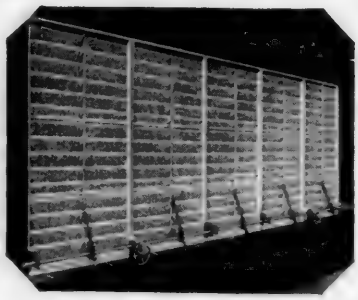
Guard against control failures on your equipment the way leading companies do—specify Allen-Bradley *quality* motor control. You *cannot* do better!

Allen-Bradley Co., 1330 S. Second St., Milwaukee 4, Wis. • In Canada: Allen-Bradley Canada Ltd., Galt, Ont.



BURT LOUVERS ARE VITAL VENTILATING EQUIPMENT

Air removed from a building with gravity or fan ventilators *must* be replaced. Burt Wall Louvers, with fixed or adjustable blades, provide efficient, weatherproof air inlets. The Burt line is complete, from general purpose models to industrial types and includes removable screens, louver operators and other accessories. Burt experience and specialized equipment also provide every facility to economically construct special units when required.



Series of Burt Adjustable Louvers

Send for **FREE** *Data Book!*

Write for Burt Data Book SPV-17-B. It Supplies quick data on Burt's complete line of modern Wall Louvers.

FAN & GRAVITY VENTILATORS • LOUVERS • SHEET METAL SPECIALTIES

The Burt Manufacturing Company

49 E. South St. Akron 11, Ohio

MEMBER AIR MOVING & CONDITIONING ASSO. INC.

Briefly Stated

(Continued from page 142)

From among an anticipated 1,000 experts in this field from all parts of the United States, Canada and Mexico, will come approximately 75 technical papers to be presented during the conference's 15 sessions. Among the titles of sessions scheduled are Flue Fed Incinerators, Organic Solvents, Combustion of Fuels, Radiological Aspects of Air Pollution, Simple Techniques Used in Solving Everyday Air Pollution Problems, Health Aspects of Air Pollution, Zoning from an Air Pollution Point of View, Automobile Exhausts, and Atmospheric Monitoring. . .

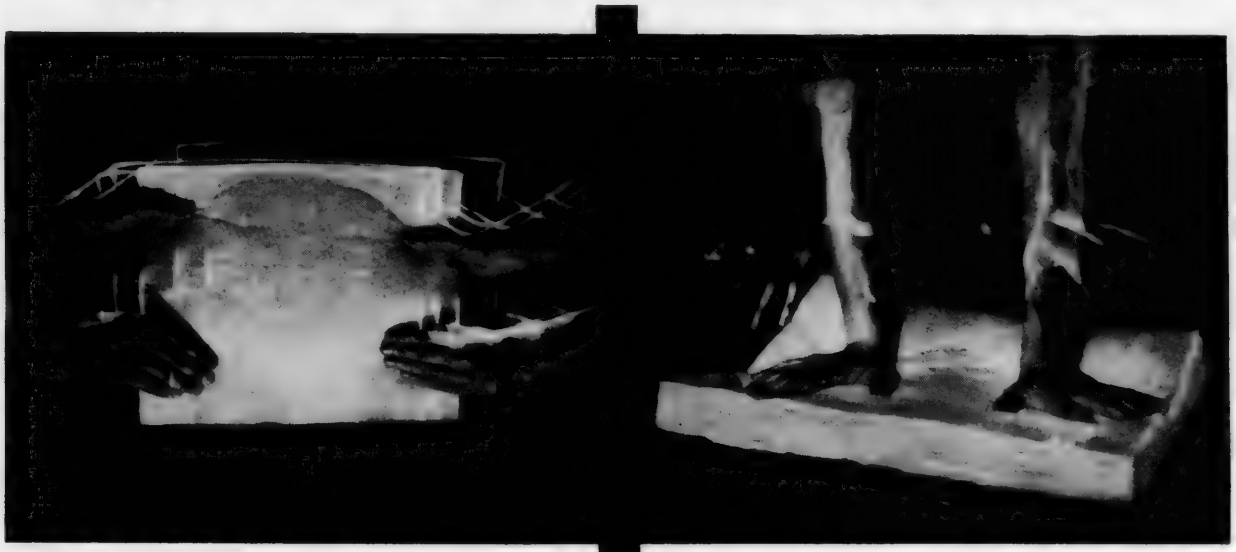
Arnold Arch has been named APCA executive secretary. He leaves the air pollution control directorship of Niagara Falls for his new post on July 1. Arch will also serve as Senior Fellow of Mellon Institute, heading the Institute's APCA-sponsored Multiple Air Purification Fellowship. He succeeds Harry Pier who served as APCA's executive secretary for the past two years after 45 years at Research Cottrell, Inc. . .

Harry Lasky, vice-president in charge of sales of Pennsylvania Range Boiler Co., of Philadelphia, Pa., was unanimously re-elected chairman of the WATER HEATER DIVISION of the GAS APPLIANCE MANUFACTURERS ASSOCIATION. Mr. Lasky's term will run for one year. Others elected were A. F. Cassidy, vice-chairman, national manager, marketing, Rheem Mfg. Co.; Executive Board Member, W. Glen Oslin, vice-president and general sales manager, John Wood Co. . . .

Rudolf G. ("Rudy") Berg, vice-president of Copeland Refrigeration Corporation, was elected president of the AIR-CONDITIONING AND REFRIGERATION INSTITUTE at its annual meeting in Hot Springs, Va. He succeeds Don V. Petrone, president of Typhoon Air Conditioning Company. Two men who have played important parts in the growth and development of the air-conditioning and refrigeration industry, and who

(Continued on page 146)

Try these 3 tests with Pittsburgh Superfine Fiber Glass Insulation



PULL IT—see how strong Pittsburgh Superfine is! It's built to last wherever you install it. It retains this same strength indefinitely. Won't disintegrate or rot with age.

PRESS IT—and see how it returns to its original shape. You can compress Pittsburgh Superfine for long periods of time, yet it will always spring back to its former shape!

PITTSBURGH SUPERFINE FIBER GLASS is great for insulating against heat or cold or noise. It's lightweight, cuts easily to correct size . . . is rot-proof, fire-resistant . . . handles easily, avoids skin irritation . . . saves installation time. Try it!

For complete information on Pittsburgh Superfine, call your nearest PPG Sales Office, or write to *Pittsburgh Plate Glass Company, Fiber Glass Division, One Gateway Center, Pittsburgh 22, Penna.*

GIVE IT A BEATING—and see how Pittsburgh Superfine absorbs the shock, and comes back. Pittsburgh Superfine loves rough handling.

PITTSBURGH SUPERFINE INSULATION IS A PRODUCT OF THE FIBER GLASS DIVISION OF PITTSBURGH PLATE GLASS COMPANY

Sales Offices are located in the following cities: Charlotte, Chicago, Cincinnati, Cleveland, Detroit, Houston, Los Angeles, Minneapolis, New York, Philadelphia, Pittsburgh and St Louis

FIBER PPG GLASS PITTSBURGH PLATE GLASS COMPANY

Low headroom!

How compact, packaged Cleaver-Brooks Progress boilers' low headroom simplifies installation in tight quarters: example — Peerless Automatic Machine Co.

Presto! A simple decision helped this Cleveland company transform a headache into a blessing.

Their problem was to install a 60 hp boiler in a room with unusually low headroom (only 86 inches floor to ceiling) without expensive and extensive structural work.

They selected a packaged Cleaver-Brooks Progress boiler for heating their plant and offices. This unit, because of its 70-inch height and compactness, gave them 16 inches of headroom above the vent. It was a neat fit and there were subsequent benefits, too:

Reported Mr. A. C. May, President, "Our oil and gas-fired Progress is very responsive, holds flue gas temperatures low and combustion efficiency high."

Why don't you, too, investigate. Discover why you'll be money ahead with a quality-built Cleaver-Brooks Progress boiler (7 sizes to 2,010,000 Btu)—in initial cost, in operating cost, in lasting high efficiency and free starting service. See your representative or write CLEAVER-BROOKS COMPANY, Dept. G, 339 E. Keefe Ave., Milwaukee 12, Wisconsin.

Cleaver Brooks®

ORIGINATOR AND LARGEST PRODUCER OF PACKAGED BOILERS

Picture shows Progress Boiler being lowered through a 58-inch wide opening in the boiler room ceiling.

Briefly Stated

(Continued from page 144)

have both been active in its trade associations over the years, were honored at the meeting. They are Stewart E. Lauer, former president of York Corporation and chairman of the board of York Division, Borg-Warner Corporation, and K. B. Thorndike, who retired this spring as vice president of American-Standard's Detroit Controls Division. They were presented with engraved silver Revere bowls. The presentation to Mr. Lauer was made by Matthew M. Lawler, vice-president of Worthington Corporation and past-president of ARI, and to Mr. Thorndike by Herman F. Spoehrer, vice president of Sporlan Valve Company and past-president of Refrigeration Equipment Manufacturers Association, a predecessor organization of ARI. . .

BURGEONING BUSINESS

SCOVILL MFG. CO., Waterbury, Conn., formally opened its new Brass and Copper Tube Mills at New Milford, Conn., on May 7. A culmination of five years of planning and building, the new mill resulted from a decision by the company to get into the copper and brass tube business in a bigger way. The 6½ acre, $10 million plant produces copper tube and pipe, general commercial tube and heat exchanger tube, in many alloys, in lengths up to 100 ft (as compared to 40 ft heretofore). Turner Construction Co., New York, N. Y., was the general contractor. . .

SUNDSTRAND CORPORATION is the new name for Sundstrand Machine Tool Co., Rockford, Ill., and Sundstrand Hydraulics is the new name for the corporation's Sundstrand Hydraulic Division. . .

Shipments of Arkla-Servel gas air conditioning units in March passed the 1,000 mark for the first time in history, and shipments for the first quarter of 1959 broke all previous quarterly records, according to Arkla Air Conditioning Corp., Evansville, Ind. A total of 1,090 units were shipped in March, compared to 574 in March, 1958,

(Continued on page 148)

Steel pipe at its best——BETH-CO-WELD

for Homes, Schools, Factories, Hospitals, Apartments, Office Buildings

Wherever it is used—in drainage lines, in ventilation, gas or water lines—steel pipe installs fast, works easily and lasts for generations.

Beth-Co-Weld is steel pipe at its best. Made under rigid quality controls on our modern continuous-weld mills, it's uniform in every way that counts: physical properties, size, wall, length. Sound and strong, it takes rough handling and hard service without damage. Our jobbers stock a full range—and Bethlehem stands solidly behind every length.

Beth-Co-Weld steel pipe is available, black and galvanized, in sizes from ½ in. to 4 in. nominal, and in lengths of 21-ft (±1 in.) or in random or cut lengths. Next time you specify general purpose pipe, ask for Beth-Co-Weld.

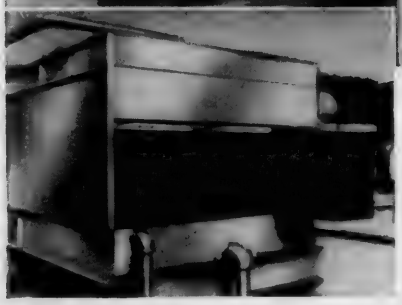
BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. *Export Distributor:* Bethlehem Steel Export Corporation

BETHLEHEM STEEL

BETHLEHEM STEEL

Above: Condenser cooling water, for steam treating equipment used in milk-flavor control, is dropped from 100° F to 80° F in this 50-ton Binks Watertemp cooling tower.



Left: Plastic decking packages slide out for easy cleaning maintenance.

AT BORNHOFF DAIRY...

New cooling tower design makes maintenance easy

"In a dairy, all processing equipment must be spotlessly maintained," reports Mr. Harvey Bornhoff, partner of Bornhoff Dairy, Inc., Glenview, Illinois. "That is why we like our Binks Watertemp cooling tower. In addition to doing an efficient job of cooling condenser water under all weather conditions, the tower is a snap to maintain and clean."

No spray nozzles to clean

"Water just comes in at the top of the tower. It spreads out over a distribution pan, that has holes in it, and starts down through the tower."

Slide-out plastic decking

"The multi-finned plastic decking slides right out of the tower in easy to handle packages. Hosing down and clean-up can be thorough. With decking out, we also have complete inside access to the tower."

Needs no paint

"We won't have to paint the tower either. All parts were hot-dipped galvanized after fabrication to make them completely weatherproof."

Free specification details

Send for Bulletin WT 501. Contains the details you need to specify big tower performance that has low bid potential. Get a copy from your nearest Binks Branch Office or write direct.

0327

Binks

EVERYTHING FOR WATER COOLING

A COMPLETE LINE OF NATURAL DRAFT AND MECHANICAL DRAFT COOLING TOWERS AND INDUSTRIAL SPRAY NOZZLES

Binks Manufacturing Company

3120-38 Carroll Ave., Chicago 12, Ill.

REPRESENTATIVES IN PRINCIPAL U.S. & CANADIAN CITIES • SEE YOUR CLASSIFIED DIRECTORY

Briefly Stated

(Continued from page 146)

and compared to 931 in the best previous month experienced by Arkla. The totals includes the 3½ and 5-ton residential-small commercial models, and the 25-ton chiller designed for commercial and industrial cooling. . .

Opening of a new branch office in Halifax, Nova Scotia, was announced by the Powers Regulator Co., Skokie, Ill. . . .

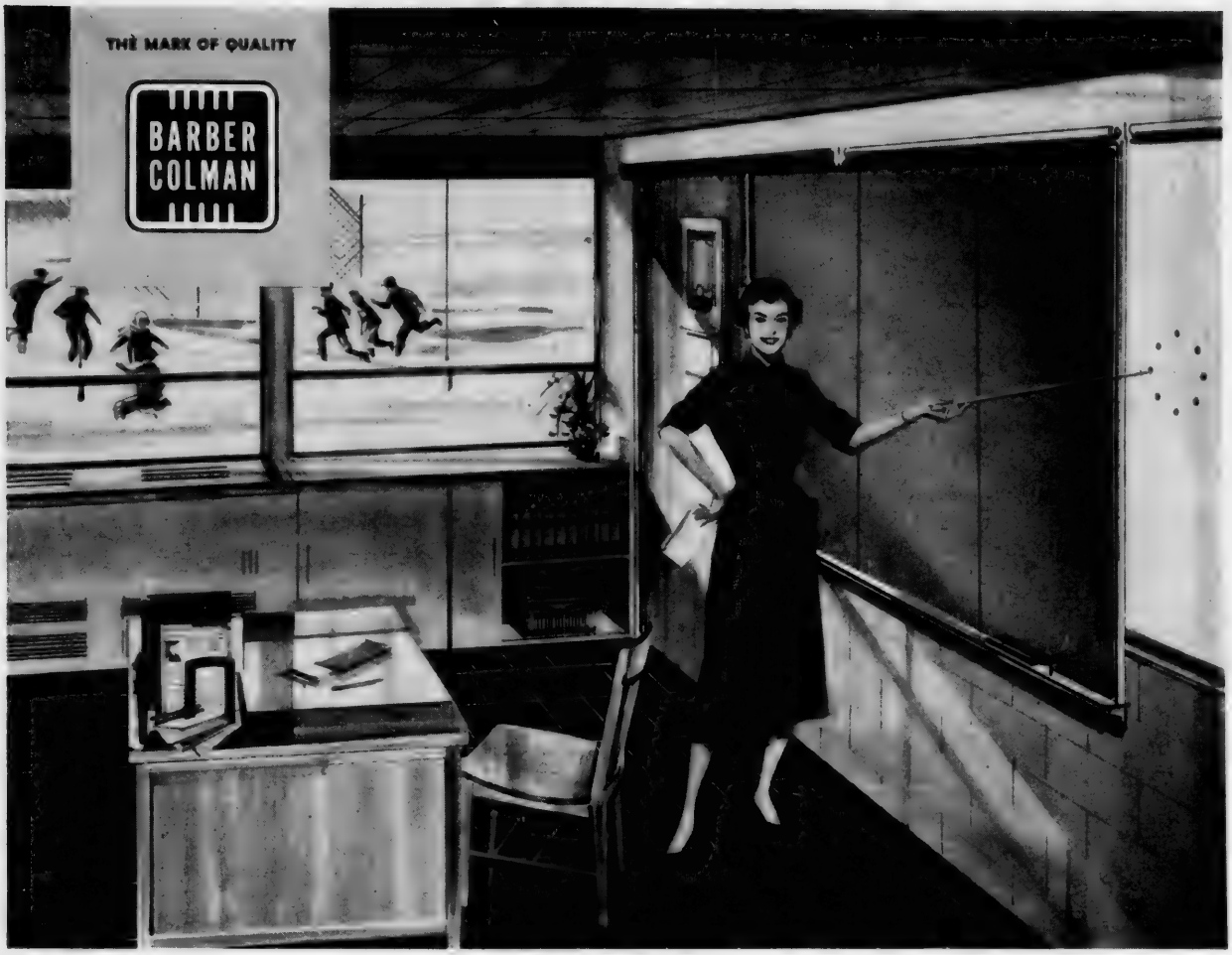
Midwest Piping Co., Inc., St. Louis, Mo., has purchased for cash from the Sparton Corp., Jackson, Mich., the physical assets of two Sparton subidiaries, Flori Pipe Co., St. Louis, and Houston Pipe & Steel, Inc., Houston. Midwest intends to operate both new properties as divisions of the company, retaining present personnel, who are to be, it is said, integrated by degrees into Midwest's over-all organizations. In addition to the new properties, Midwest operates two major plants in St. Louis, one in Los Angeles and one at Clifton, N. J. . . .

Mackenzie Walton Corp., Pawtucket, R. I., is celebrating its 50th birthday. Its precision seamless tubing of copper and copper base alloys is used extensively in such fields as instrumentation, bourdon gage, air conditioning, refrigeration. thermostatics, automotives and band instruments. Mackenzie is now a wholly-owned subsidiary of Reading Tube Corporation. . .

Establishment of a Production Planning Department with Herbert G. Hock as manager has been announced by WEIRTON STEEL COMPANY, division of National Steel Corporation. The primary function of the new department will be the coordination of sales and production, forecasting, scheduling and control of working inventories. Mr. Hock has been with Weirton since July 1939, when he joined the Metallurgical Department. . .

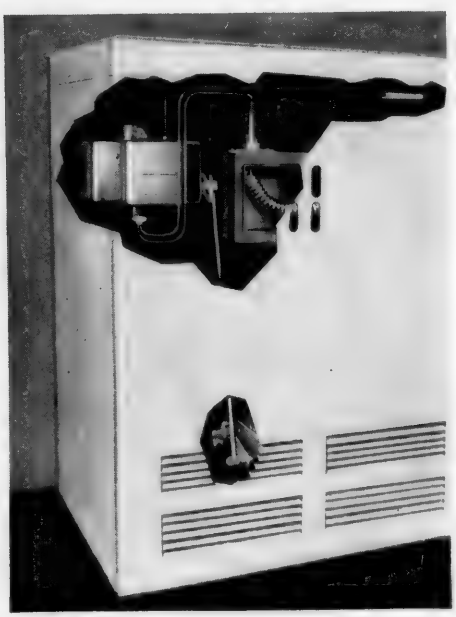
YORK-SHIPLEY, INC., York, Pa., has recently received its eleventh order in twelve years from Levitt

(Continued on page 151)



Look...no wall thermostat!

New Controls with Unit-Mounted Thermostats Are . . .



All controls are inside

MORE ACCURATE • PROTECTED FROM DUST

TAMPERPROOF • FASTER RESPONDING

Barber-Colman now offers the most advanced "packaged" control systems" for every unit ventilator installation — steam, hot water, hot and chilled water, gas and electric.

All elements of a Barber-Colman unit ventilator control system, *including the thermostat,* are mounted within the unit ventilator enclosure. This eliminates the need for a wall-mounted thermostat, substantially reducing installation costs and providing greater control accuracy. It also means that factory installation of controls is practical.

Having the thermostat mechanism enclosed in the unit eliminates chalk dust and dirt problems. Temperature tampering is also eliminated. Even more important, unit mounting permits superior control through the use of the "dual element" aspirated thermostat principle. This is the approved temperature control principle employed in the most exacting laboratory installations.

Ask for booklets entitled "Better Control Electrically" and "Unit Ventilator Application File." These two new booklets explain why Barber-Colman electric control is superior and give specifications and details on control systems for all leading makes and models of unit ventilators. Call your Barber-Colman representative or write today.

BARBER-COLMAN COMPANY

Dept. R, 1302 Rock Street, Rockford, Illinois

Advantages of Constant Volume Regulators in High Velocity Air Transmission

. . . greater design flexibility, stable air delivery, self-balancing operation of branch ducts are typical benefits

The function of a constant volume regulator is twofold:

1. To reduce high velocity air to conventional velocities;
2. To deliver a constant cfm flow as supply duct pressures change.

Constant volume regulators provide automatic compensation for static pressure variation, and assure balanced system performance under a wide range of operating conditions. Barber-Colman now makes available a line of standard constant volume regulators and control units to meet nearly every application.

Model SCR Regulator

The completely self-contained, self-operated Barber-Colman constant volume regulator, illustrated in Fig. 1, has proved to be a highly accurate and reliable device. It can be installed anywhere in a single- or double-duct system to maintain constant cfm delivery, regardless of pressure changes upstream or downstream, including those caused by operation of mixing valves or face and bypass dampers.

As illustrated, a flexible diaphragm is actuated by changes in static pressure to control the area of the discharge opening. No separate power source is required. The regulator will operate on as little as 0.5 inches of static pressure in the duct.

Both static and velocity pressure exist under the flexible diaphragm where the air can pass through the discharge plate. Static pressure exists only above the diaphragm where the air is trapped. A static pressure increase above the diaphragm forces it downward against spring pressure, limiting the open area. Conversely, when static pressure decreases, the diaphragm raises, exposing a larger opening area.

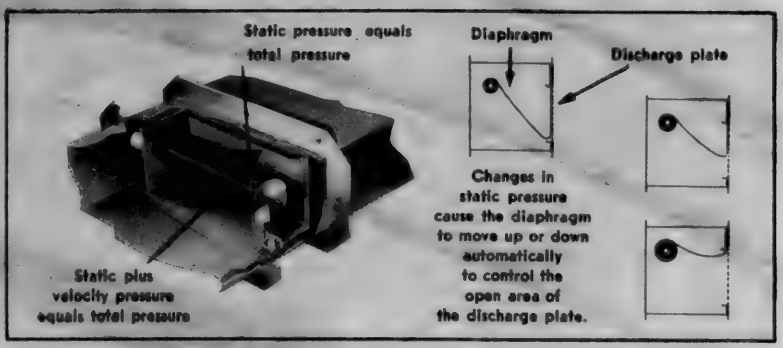

Static pressure equals total pressure
Diaphragm
Discharge plate
Changes in static pressure cause the diaphragm to move up or down automatically to control the open area of the discharge plate.
Static plus velocity pressure equals total pressure

Fig. 1 — Model SCR constant volume regulator can be installed anywhere in a duct system where there are changes in static pressure. It maintains cfm delivery within ±5% for inlet air pressure differences as high as 6 to 1.

The spring tension of the diaphragm roller is set at the factory to meet job requirements, but it can be easily adjusted in the field should requirements change.

Double-Duct Control Units

Three basic types of Barber-Colman double-duct control units combine the basic constant volume regulator with hot and cold air mixing valves. The two valves are controlled by a single motor operator as illustrated in Fig. 2. The housing is acoustically lined to assure very low noise levels.

Standard units meet above-the-ceiling, under-window, or sidewall installation requirements in the vast majority of cases. Modified units are available for unusual situations.

Figs. 3 through 7 illustrate typical applications and the design flexibility of these regulators and control units.

New High Velocity Manual

A new 52-page manual has been developed by Barber-Colman to provide engineers a handy reference source to high velocity design considerations. In addition to a general discussion, it includes data on duct design, air requirements, return air systems, fan selections, temperature control, balancing procedures, and Barber-Colman control units.

Ask for Catalog No. F-6598-1. Call your local Barber-Colman air distribution field office or write.

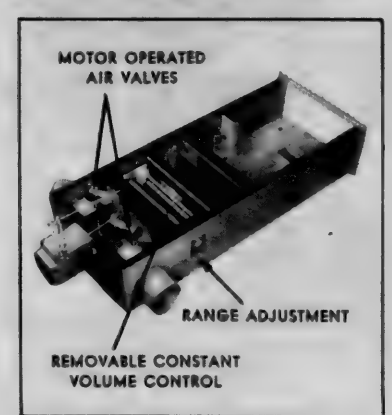


Fig. 2 — Model CV double-duct control unit combines mixing valves with a constant volume regulator.

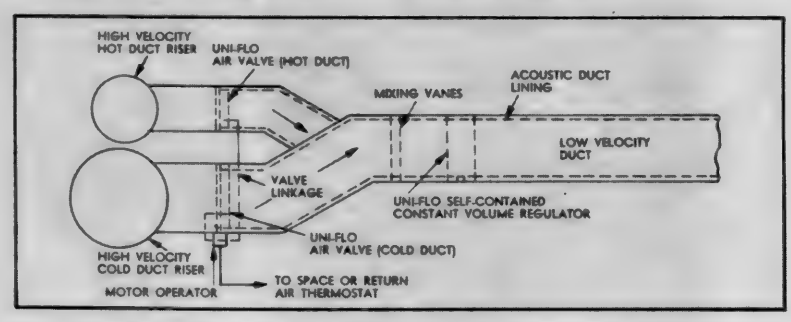


Fig. 3 — Double-duct system with motor-operated air valves for hot and cold air mixing and a model SCR regulator to provide constant cfm delivery to the low velocity duct. A Model CV unit (Fig. 2) could be used instead of the two valves and the single SCR regulator.

Instead of a single SCR regulator, individual ones can be installed in branch ducts. In this case, the low velocity duct system would be self-balancing.

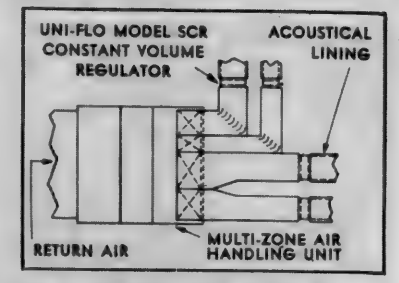


Fig. 4 — Multizone system with SCR regulators in each zone to provide constant cfm delivery.

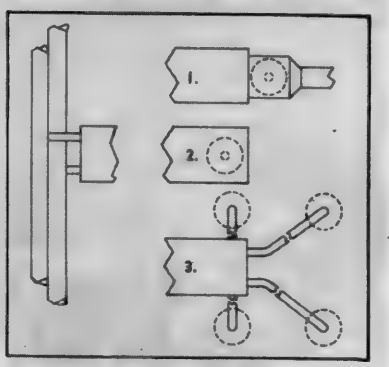


Fig. 5 — Double-duct system illustrating several applications of Model CV control units. Circles indicate ceiling diffusers. (1. CVE open-end unit; 2. CVD with integral diffuser; 3. CVO with octopus outlets.)

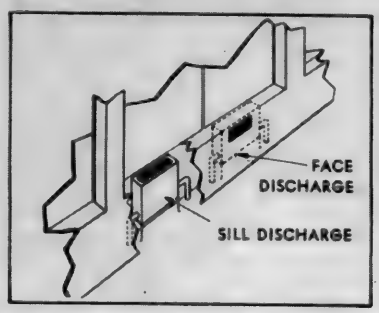


Fig. 6 — Double-duct control unit for under-window mounting. Model SWC furred-in units shown.

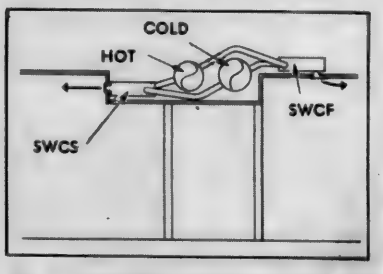


Fig. 7 — Model SWC double-duct control units installed above ceiling for use with ceiling and sidewall diffusers.

BARBER COLMAN
Uni-Flo
ENGINEERED
AIR DISTRIBUTION
BARBER-COLMAN COMPANY
Dept. R, 1102 Rock Street, Rockford, Illinois

(Continued from page 148)

& Sons, Inc., the world's largest builder of residential housing. The current order is to cover Levitt's entire 1959 boiler-burner unit requirements for their Levittown, New Jersey, community. This order is a blanket order covering the exact number of houses which will be built and sold during the year, and it is estimated that the quantity will reach several thousand units at an approximate value in excess of one-half million dollars. . . .

A new name in the automatic controls field is SIGNET CONTROLS, who will manufacture a line of products for the heating and air conditioning industries. The new organization is an outgrowth of the heating controls department of IRON FIREMAN ELECTRONICS DIVISION. A modern factory in Portland, Ore., will be headquarters. A line of controls similar to those made by the Iron Fireman Electronics Division will be produced. However, it is said that the Signet Controls line will be broader from the outset, with more types and models being offered. . . .

The Bettcher Manufacturing Co., Cleveland, Ohio, purchased the Thermobloc Division, from Prat-Daniel Corp., South Norwalk, Conn. Panelbloc Infra-Red Heaters and Thermobloc Heaters will now be manufactured and sold by the PANELBLOC DIVISION OF THE BETTCHER MANUFACTURING CO. The new Division will have its headquarters at 3106 West 61st St., Bettcher's main plant.

NEW REPRESENTATIVES

BALTIMORE AIRCOIL CO., INC., Baltimore, Md., announces the recent appointment of three new representatives to handle the sale of their B.A.C. evaporative condensers and cooling towers: Roger G. Anderson of F. W. Jenike Co., in Cincinnati, will handle the line in southwest Ohio and nearby areas of Kentucky and Indiana. Samuel Paschal is in charge of the J. P. Ashcraft Co., Inc., Oklahoma City Office that has recently taken over B.A.C. products in all of Oklahoma. The most recent appointment is H. George Richardson of Richardson Equipment Co., Boise, Idaho., to cover all of central and southern Idaho. . .

THE JACKSON & CHURCH DIVISION OF YORK-SHIPLEY, INC. announced that Friemel-Love Co., 6548 Clayton Road, St. Louis 17, Mo., will be its sales representative in Eastern Missouri and Southern Illinois for its line of warm air commercial, industrial and institutional furnaces, it was announced. . .

Albert Weiss Air Conditioning Products, Inc., New York, N. Y., is appointed to represent BUENSOD-STACEY, INC., for New York sales of dual duct air mixing units and other products. Albert Weiss, who has specialized in the air distribution field for some thirteen years, formed the new company earlier this year to represent manufacturers of various types of equipment in air handling and conditioning industry. . .

AMERICAN AIR FILTER CO., Louisville, Ky., has appointed R. M. Toucey as its exclusive representative in the Pittsburgh area for its Herman Nelson unit ventilator products for schools, Herman Nelson heating and ventilating products, and its Illinois Engineering Division heating systems and controls. His office is located at 306 Beverly Road (P. O. Box 8051).

UP ON TOP

A. James Hackl has been named general manager of WORTHINGTON CORPORATION'S AIR CONDITIONING AND REFRIGERATION DIVISION. He will be located in the division's main office at the Ampere Works in East Orange, N. J. (Other division installations producing commercial and residential air conditioning and refrigeration units are located in Decatur, Ala., and Holyoke, Mass.) Prior to joining Worthington, Mr. Hackl was associated with Trane Company as general sales manager for the firm's packaged air conditioning products. . .

AirMpeler
LO-BOY
CENTRIFUGAL
ROOF EXHAUSTERS

Enhance The Beauty Of Building Skylines

Pats. Pend.

Lowest Silhouette Design

FORWARD OR BACKWARD CURVE WHEEL WITHIN . . . . OR OUT OF SCROLL HOUSING

Motor mounting on side of structure support . . . out of line of air stream reduces height of Lo-Boy models nearly 50% of older designs.

LOW WIND RESISTANCE
SIZES 10"-72" 600-47,000
CERTIFIED C.F.M. RATINGS

• QUALITY • BEAUTY
• PROVEN PERFORMANCE

See Sweet's File 20c/Amm or Write for bulletin AC-100-59

AMMERMAN CO., INC.
P. O. Box 182 Shillwater, Minnesota
MEMBER OF THE AIR MOVING & CONDITIONING ASSN.

Briefly Stated

Charles H. Lovelace was appointed general manager of engineering sales, CRANE CO., Chicago, Ill. He joined the company in 1938, and has been in charge of its industrial sales and merchandising for three years. . .

K. B. (Spike) Thorndike, retiring after 35 years as vice-president and eastern regional manager of AMERICAN - STANDARD'S DETROIT CONTROLS DIVISION, was honored at the Division's recent national sales meeting. . .

J. T. Conlon has been elected president of GUSTIN-BACON MFG. CO., Kansas City, Mo., succeeding J. D. Simmons, who will continue with the company as a director and consultant. Mr. Conlon joined Gustin-Bacon in 1937, in the company's sales department. He subsequently became chief engineer and vice-president in charge of engineering. In April of 1958, he was elected executive vice-president.

GUSTIN-BACON MFG. CO., Kansas City, Mo., manufacturers of thermal and acoustical glass fiber insulation, further announced the appointment of F. W. "Bud" Muller as vice-president and general sales manager. Prior to joining Gustin-Bacon in 1954, Mr. Muller was sales manager of Calumet Hecla Mining Company. . .

Appointment of Frank E. Purcell as sales manager of packaged equipment for the UNITARY EQUIPMENT DIVISION OF CARRIER CORP., Syracuse, N. Y., is announced. Mr. Purcell, who has been sales manager of the national buyer department at Carrier since 1956, will be in charge of air conditioning and heating equipment for both residential and commercial application. Products under his direction include room air conditioners, furnaces, central air conditioners, heat pumps, automatic icemakers, and heating and cooling units for mobile homes. He succeeds Burton T. Kehoe who recently was appointed executive vice president of Colorado Research Corp., a Carrier subsidiary. . .

WHY THERE'S NO "OR EQUAL" WHEN YOU SPECIFY WIREMOLD AIR DUCT

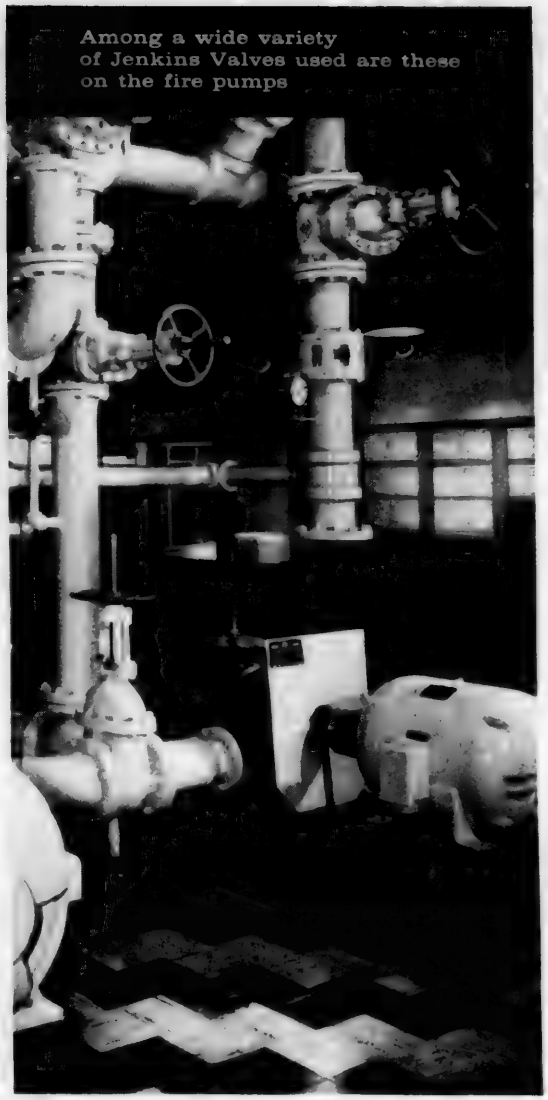
Unlike any other flexible air duct, Wiremold Air Duct is made with a *flat* metal spiral that *mechanically locks* to the fabric component. Here's what this construction means to you:

- With Wiremold you get a *mechanically locked* seam the same as you insist upon with sheet metal duct. There are no glues or adhesives that may dry out and fail with age.
- Wiremold's exclusive *flat* metal spiral assures accurate size — and snug connections.
- Cuffed ends (and cuffing equipment) are never needed.
- Unlike ducts with cuffed ends, Wiremold's fabric and metal are *both* secured to end fittings, making stronger connections.
- Two lengths of Wiremold can be joined simply by screwing them together. No collars or clamps are needed.

FOR AIR CONDITIONING • EXHAUSTING MATERIALS HANDLING • MANY OTHER USES

WIREMOLD® AIR DUCT

ask your distributor, or write
THE WIREMOLD COMPANY • HARTFORD 10, CONN.



Chicago's Tallest Office Building

Mid-America Home Office of **The Prudential Insurance Company of America** relies on JENKINS VALVES

Well-known for careful selection of investments and concern about controllable operating expenses, The Prudential Insurance Company of America sought the soundest of values when building its new 40 million dollar Mid-America Home Office building.

This applied to the valve equipment, and the contractor installed *Jenkins Valves* to control the plumbing and sprinkler systems. Made for a Lifetime of service, and to a known quality standard which has been unvarying for nearly a century, Jenkins Valves provide the fullest protection against costly valve maintenance and replacement.

It is protection that can save money for any plant or building. And, you can specify or install Jenkins Valves knowing they cost no more. Jenkins Bros., 100 Park Avenue, New York 17.

Architects: NAESS & MURPHY, CHICAGO

General Contractor: GEORGE A. FULLER CO., CHICAGO

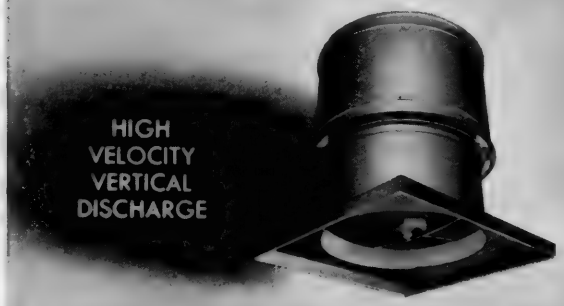
Plumbing and Sprinkler Contractor.
M. J. CORBOY CORP., CHICAGO

JENKINS
LOOK FOR THE DIAMOND
VALVES
JENKINS
SINCE 1864
Jenkins Bros.

Sold Through Leading Distributors Everywhere

Two Top Allen
ROOF VENTILATORS
Here are two widely-used roof fans, typical of Allen engineered ventilation for modern structures and industrial uses:

- Recommended whenever specifications call for a roof fan of low contour without sacrificing high operating efficiency
- Low noise level • Low first cost • Low maintenance
- Easy to install (no extra bases needed) • Easily accessible
- Wide capacity range (420-45,000 cfm) • Belt or direct drive



- Recommended where extremely high discharge velocity is needed to keep fumes from sifting back into the building
- Automatic wing dampers • Capacities up to 90,000 cfm
- Direct drive (moderately dry temperatures up to 160° F.)
- Remote drive (corrosive or high temperatures up to 350° F.)

See Sweet's for the complete Allen line of roof ventilators

MAIL COUPON for specifications and performance data on these and other Allen units

ALLEN ENGINEERED VENTILATION
ALLEN COOLER & VENTILATOR, INC.
ROCHESTER, MICH.
Roof Ventilators for Every Commercial and Industrial Need
REPRESENTATIVES IN PRINCIPAL CITIES

ALLEN COOLER & VENTILATOR CO.
712 WOODWARD AVE., ROCHESTER, MICHIGAN
Please send catalog of the Allen ventilator line, including specifications and data on the I-line and VD roof fans.

Firm
Name
Address
City Zone State

Sizing of Steam Heating Equipment

(Concluded from page 103)

system when it is cold after a shutdown over night. Since most of pumps are of the duplex type (two pumps and a single tank), the combined capacity is not three but six times the normal rate of condensation. However, data included in the 1959 ASHAE *Guide* and especially the curve shown in Fig. 21 in Chapter 26 seem to show that the peak rate of condensation is only 30% higher than the normal rate. The peak condensation rate will depend on the room temperature at the time of starting up, but even if 50 deg is assumed, the peak load will still be only some 50% higher than normal.

In connection with the boiler, the *Guide* states that 20% is the usual addition for pick-up load with automatic firing. Why then the 200% at the return end of the piping when the boilers are not sized to generate that much excess steam? It would seem as if sizing the pumps for 50% excess capacity (that would be 100% with both pumps running) would be ample. This would reduce the motor sizes and wiring, with savings in the installed cost. Of course the pumps would run more hours per day which would increase the wear but this would be more than offset by the lower power consumption and the lesser wear on magnetic starters. There would be a reduction in connected load which might result in a lower power rate. In other words the writer suggests that not only pipe sizing practice but other procedures as well might stand further examination and study.

WHAT READERS SAY

Commercial Kitchen Ventilation

EDITOR, Air Conditioning, Heating and Ventilating

It appears that the main purpose of your recent article on commercial kitchen ventilation* was to try to prove to the advantage of the gas industry that the cooling and ventilating requirements are the same for gas or electrically operated heavy duty kitchens. However, from the argument presented, the only decisive conclusion that can be drawn is that under no conditions can one afford to use refrigerated air for cooling in a large commercial or institutional kitchen. To advance this theory would seem to me detrimental to the air conditioning industry as a whole.

To illustrate how expensive cooling would be under these conditions, let's look at a typical institutional kitchen 40 feet by 60 feet with a 12 foot ceiling. The volume would be 40 x 60 x 12 = 28,800 cubic feet. Twenty air changes per hour would require 9600 cfm. According to the article, at outside design of 90 deg. d.b. and 75% relative humidity, each 1000 cfm of fresh air would require 4.5 tons of refrigeration to bring it to room conditions of 80 deg. d.b. and 65% relative humidity. On this basis 43.2 tons (4.5 x 9.6) would be required for outside air alone.

As stated in the article, the purpose of an exhaust system is to remove heat, odors and grease laden vapors. Therefore, it seems only logical that some consideration

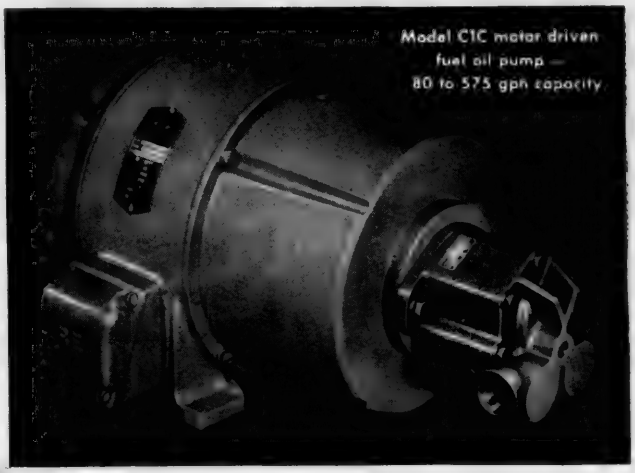
* Commercial Kitchen Ventilation And The Effect of Cooking Appliances On Air Conditioning Design, Edgar A. Jahn, ACH&V, April, 1959.

(Concluded on page 156)

Webster fuel oil handling equipment

from tank to burner—
a complete line for all commercial and industrial applications

Problems in handling fuel oils? High lift, big capacity, heavy No. 5 and No. 6 grades? Webster has the answer in a full line-up of pumps—supply, transfer, booster and burner models. Choose from direct drive or belt-driven units—in a wide capacity range. Webster pumps are compact, install with a minimum of plumbing. With each you get a full measure of dependable operation to match the most rugged and demanding service.


Model C1C motor driven fuel oil pump — 80 to 575 gph capacity

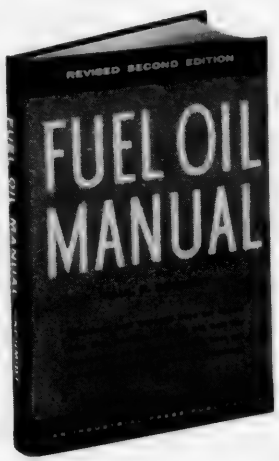
RV-2000 fuel oil regulating valve
For all fuel oils — No. 1 through No. 6. Combines pressure regulation and cut-off. Capacities up to 100 gph. Pressure ranges — 80 to 150 psi, 90 to 250 psi.

call the man from Webster

— or write for engineering bulletins FU3-1, FU3-2, FU3-3

HEATING DIVISION
WEBSTER ELECTRIC
RACINE · WIS
our 50th year

Reprint ads A-130



Here is a book that will give you a comprehensive picture of the characteristics and uses of every type and grade of fuel oil. The author explains the meaning of each oily property, and shows how this information is applied to the selection, handling and burning of fuel oil. Impurities and how they effect combustion are described fully, and a special chapter describes fuel oil additives and how they are used. Another chapter lists troubles which may be encountered in using fuel oils, and shows the correct remedy to apply in each case. Technical language is avoided wherever possible and all terms are fully explained.

160 Pages **4.50** 34 Tables

By mail order, Canada or overseas, $5.50

THE INDUSTRIAL PRESS
93 Worth Street New York 13, N. Y.

To order, circle letter K on postcard, last page.

....to beat sun heat
SPRAY NOZZLES
for evaporative
ROOF COOLING...

Reduce indoor temperatures on hot sunny days 10 to 20 degrees . . . decrease cost of air conditioning systems by lowering tonnage needs in refrigeration. Complete choice of spray nozzles . . . non-clogging, Whirljets, with cone spray . . . and water saving Streamjets.

For complete information write for Roof Cooling Bulletin 81.

SPRAYING SYSTEMS CO.
3261 Randolph • Bellwood, Illinois

ADVANCED SPRAY NOZZLE DESIGN FOR NEW DIMENSIONS IN CONTROL AND PERFORMANCE

(Concluded from page 154)

should be given to the amounts of each involved. Cooking odors would be the same but heat would be 1.6 times as much in a gas-fired kitchen, according to Mr. Jahn, and unquestionably there would be more moist and grease laden air in a combustion operated kitchen.

The institutional kitchen mentioned above has a connected cooking load of 100 kw. On the basis of 50% diversity, the total hourly heat gain from this equipment would be 170,750 btu or 14.2 tons of refrigeration. Add to this enough ventilation air to remove all cooking odors and moisture from the cooking process and it should total considerably less than 43.2 tons. Too, cooling as well as ventilating will be acomplished.

On the basis of the amount of outside air recommended by Mr. Jahn, it would doubtless make no difference what kind of cooking fuel is used. However, if desirable comfort conditions are to be attained, cooling as well as ventilating will be required. As a practical matter, this can be done only when electric cooking equipment, which requires no air for combustion, gives off no distasteful by-products, and requires much less heat to do a cooking job, is employed.

I am not trying to discount the need for or value of good ventilation in heavy duty kitchens. But to make it appear that ventilation requirements are so great that refrigerated cooling is impracticable hurts the industry. We have air conditioned kitchens in our area where cooling costs are considerably less than indicated in the article.

M. E. Price
Consultant

Department of Marketing and Development,
Mississippi Power & Light Co.,
Jackson, Miss.

Canadian Degree-Days for April, 1959*

City	April		Cumulative	
	1959	Normal	1958-59	Normal
Calgary, Alta.	790	770	8443	8510
Charlottetown, P. E. I.	817	870	8215	7770
Crescent Valley, B. C.	630	610	7249	7210
Edmonton, Alta.	719	760	9124	9420
Fort William, Ont.	862	890	9842	9640
Grande Prairie, Alta.	828	830	10136	9930
Halifax, N. S.	752	765	7000	6762
London, Ont.	624	650	7260	6900
Medicine Hat, Alta.	657	620	8255	8130
Moncton, N. B.	776	830	8441	8020
Montreal, P. Q.	641	730	8132	7970
North Bay, Ont.	862	840	9291	9050
Ottawa, Ont.	649	730	8498	8250
Penticton, B. C.	487	490	6032	6010
Prince George, B. C.	770	740	8534	8500
Quebec City, P. Q.	809	850	9286	8810
Regina, Sask.	768	790	9893	9980
St. John, N. B.	796	830	8235	7870
Saskatoon, Sask.	709	800	9987	10190
Timmins, Ont.	976	1010	10316	10510
Toronto, Ont.	591	646	6778	6582
Vancouver, B. C.	505	480	4807	4910
Victoria, B. C.	497	470	4622	4520
Windsor, Ont.	573	580	6685	6290
Winnipeg, Man.	814	810	10303	9988

*These data are supplied through the courtesy of the Meteorological Division Air Service Branch, Department of Transport, Canada.
The Department reports slight revisions in the figures for March as published in last month's issue. Corrected figures are Charlottetown, P. E. I., 1226; Medicine Hat. Alta., 903.

World's Favorite
NON-SCALD
SHOWER VALVE

- Proven superior in thousands of installations
- Automatically holds shower temperature constant
- No sudden scalds or chills regardless of water pressure
- Built to last a lifetime . . . only one moving part
- Self-cleaning action prevents clogging — saves water

Symmons
ENGINEERING COMPANY
Dept. 3-C, 449 C STREET, BOSTON 10, MASSACHUSETTS

Send at once for Safetymix folder.

Consulting Engineers Council

Machining the head for a shell and tube vessel in the Frick shop.

TRADE FRICK MARK

SHELL VESSELS

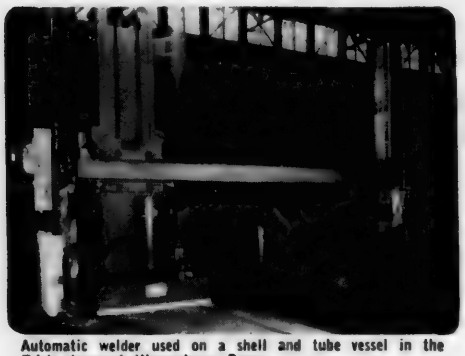
With 106 Years' experience in building pressure vessels . . . from boilers to reactors, we're able and ready to fill all your needs.

We have the shears, planers, power rolls, automatic welders and mechanics to meet all ASME standards.

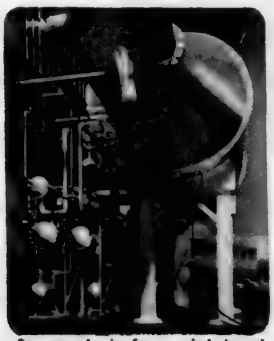
Condensers, Receivers, Oil Separators, Gas and Liquid Coolers, Accumulators, and Pre-coolers are furnished in all sizes.

WRITE FOR RECOMMENDATIONS AND ESTIMATES ON YOUR SHELL VESSEL WORK TO . . .

FRICK COMPANY • WAYNESBORO, PENNSYLVANIA



Automatic welder used on a shell and tube vessel in the Frick shops at Waynesboro, Penna.



Compressed air for a wind tunnel conditioned with Frick equipment.

Frick reactor shells are built by ASME qualified welders.

GREENHECK *Air Movement Devices*

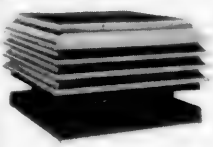
1959 "DALLAS" AIR MOVER

POWER ROOF EXHAUSTER

For the highest quality materials and workmanship at the lowest possible price, specify the GREENHECK "DALLAS" Air Mover. Features include rugged ball bearing motors completely isolated from the exhausted air stream, non-overloading backward curved wheels, vibration mountings, and highest quality sealed ball bearings for wheel shaft mounting. The hood is hinged for easy access to the motor and pulley belt area. Write today for catalog 10 which gives complete engineering information.

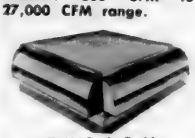
COLUMBUS

Direct Drive centrifugal power roof exhauster. 100 to 1400 CFM. Boston companion series belt drive 500 to 4300 CFM.



WAUSAU

Air Mover Belt drive centrifugal power roof exhauster. 300 CFM to 27,000 CFM range.



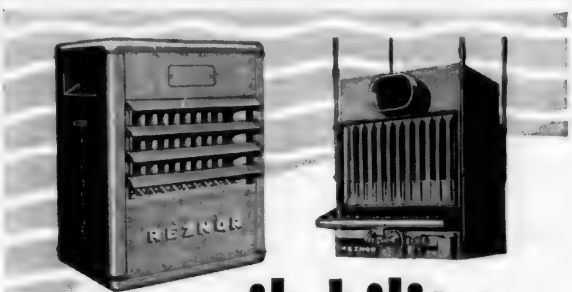
TUCSON

Air mover provides low silhouette centrifugal roof exhauster — capacity 200 to 20,000 CFM.

GREENHECK

FAN & VENTILATOR CORP.

SCHOFIELD • WISCONSIN



availability

When you specify Reznor gas heaters, you can do so with confidence that the equipment you call for will be available when it's needed, anywhere in the country. Substantial stocks of all the most frequently used models (both unit heaters and duct furnaces) are maintained by Reznor distributors in more than 200 cities. And if the units you call for don't happen to be available from distributor stocks, shipments from the factory can be made to meet any reasonable schedule.

AVAILABILITY is just one of many reasons why Reznor is right for a wide variety of commercial and industrial buildings. Ask your Reznor distributor for details or write for your free copy of "Modern Heating".

Look for Reznor under "Heaters-Unit" in the Yellow Pages

REZNOR

WORLD'S LARGEST SELLING DIRECT FIRED

UNIT HEATERS

Reznor Manufacturing Company, 64 Union Street, Mercer, Pa.

(Concluded from page 72)

proximately $5 increase in dues per member.

Program Speakers

Highlights of the four-day session were provided by two eminent speakers. At the opening luncheon A.I.A. President, John Noble Richards, discussed the responsibility and role of the architect and engineer in today's and tomorrow's society. Mr. Richard stated his belief that increased cooperation between the two professions would materially benefit the client as well as the architect and the engineer.

Principal speaker at the annual installation of officers banquet was Julian S. Tritton, President of the International Federation of Consulting Engineers, who had traveled from London, England, to welcome C.E.C. as the newest member of that organization. Mr. Tritton, who is a prominent engineer in his own right, discussed the problems and practices of consulting engineering on an international scale. The recently approved international conditions of the contract were also presented and discussed as a part of his address.

In addition to Westcott and Miles, other officers elected by the Council were: Orley O. Phillips, Denver, Col., first vice president; Howard F. Eckerlin, Syracuse, N. Y., secretary; and George A. Heft, New Orleans, La., treasurer.

COMING EVENTS

Where listed, names or titles of individuals are those from whom further information is available

ASME SEMI-ANNUAL MEETING—Semi-annual meeting of the American Society of Mechanical Engineers, Chase-Park Plaza Hotel, St. Louis, Mo. Secretary, O. B. Schier, II, 29 W. 39th St., New York 18, N. Y. ..... **JUNE 14-18, 1959.**

ASTM MEETING—Annual meeting of the American Society for Testing Materials, at Chalfonte-Haddon Hall, Atlantic City, N. J. Secretary of the Society, 1916 Race St., Philadelphia 3, Pa. ..... **JUNE 21-26, 1959.**

ASHRAE MEETING—Annual meeting of the American Society of Heating, Refrigerating and Air-Conditioning Engineers, at the Lake Placid Club, Lake Placid, N. Y. Secretary of the Society, 62 Worth St., New York 17, N. Y. ..... **JUNE 22-24, 1959.**

AIR POLLUTION CONTROL MEETING—Annual meeting of the Air Pollution Control Association, at the Hotel Statler, Los Angeles, Calif. H. M. Pier, executive secretary of the Association, 440 Fifth Ave., Pittsburgh 13, Pa. ..... **JUNE 22-26, 1959.**

ASSE MEETING—Annual meeting of The American Society of Sanitary Engineering, at the Mayflower Hotel, Washington, D. C. M. Mercury, treasurer-secretary of the Society, 4328 South Western Ave., Chicago 9, Ill. ..... **JULY 19-24, 1959.**

HEAT TRANSFER CONFERENCE—Sponsored by American Society of Mechanical Engineers and American Institute of Chemical Engineers, Heat Transfer Conference, University of Connecticut, Storrs, Conn. ASME Secretary, O. B. Schier, II, 29 W. 39th St., New York 18, N. Y. ..... **AUGUST 9-12, 1959.**

(Concluded on page 160)

IN MODERNIZATION

GRACIOUS LIVING CALLS FOR

THERMAL

When the Plaza Hotel in Houston planned to modernize its air conditioning system, Thermal multi-zone units were chosen to assure the year-around comfort of the Hotel's transient and permanent guests.

The Thermal line of quality equipment is famous for long life and efficient operation—which means it can be specified with confidence to deliver years of satisfaction. Thermal Engineering equipment includes central plant air conditioners, multi-zone air conditioners, cooling and heating coils, sprayed coil units, heating and ventilating units and air cooled condensers.

Detailed catalog available.

H. E. Bovay, Jr. — Consulting Engineers
Baxter Const. Co. — General Contractors
Massey-Graves Co. — Mech. Contr.
McMillan Equipment Co. — Thermal Sales Rep.

Agents in principal cities.

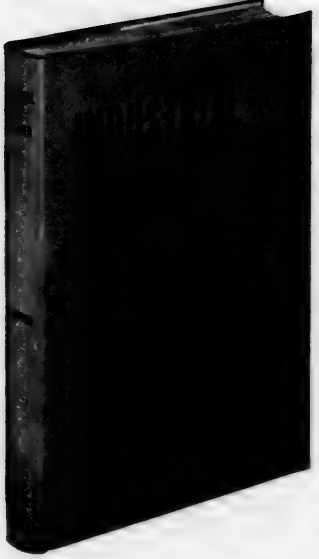
Quality Products since 1945

THERMAL ENGINEERING CORPORATION

7005 W. DALLAS • P. O. BOX 13254
HOUSTON 19, TEXAS

NEW WASHABLE AIR FILTER USES NO OIL

A new air filter panel developed by Air-Maze is completely dry, yet can be washed in cold water. Extended surface design provides more than four times the effective surface of conventional panels. Made of corrosion resistant Amylon (an inert, bonded synthetic fiber mat) encased in a galvanized frame between two layers of aluminum screen. Highly efficient, unaffected by varying air velocities and temperatures. Lasts indefinitely. Available in 1" and 2" thicknesses and in all popular sizes. Write for Bulletin 376-151, **The Air-Maze Corporation, Dept. AC-6, Cleveland 28, Ohio.**



Solve Heat Transfer Problems—Directly and Accurately!

INDUSTRIAL HEAT TRANSFER, by F. W. Hutchinson, presents 123 working graphs that permit the direct solution of complex problems of heat transfer. Use of these graphs —which are equal in accuracy to the equations from which they are derived—speeds heat transfer analysis and helps to eliminate errors in calculation. In addition to the complete text, graphs are provided for: air, acetylene, ammonia, benzene, chlorine, ethane, ether, helium, oxygen, pentane, steam, sulphur dioxide, water, and 57 other industrially used liquids and gases.

Get your copy of this valuable working reference book today!

336 Pages, 136 Charts and Illustrations—$7.00

To order your copy use the coupon below or circle letter N on postcard, last page.

THE INDUSTRIAL PRESS, 93 Worth St., New York 13, N. Y.

Please send me a copy of INDUSTRIAL HEAT TRANSFER at $7.00.

☐ I enclose payment in full. Send book postpaid.
☐ Bill me ☐ Bill company. (Postage charges will be added)

NAME .....

COMPANY .....

CITY ..... ZONE .... STATE .....

HOME ADDRESS .....
(Please fill in if you want book sent to your home)

ACHV 6/59

(Concluded from page 158)

CRYOGENIC ENGINEERING CONFERENCE—1959 Cryogenic Engineering Conference to be held at the University of California, Berkeley, Calif. K. D. Timmerhaus, secretary of the Conference, Chemical Engineering Dep't., University of Colorado, Boulder, Colo. ..... **SEPTEMBER 2-4, 1959.**

INDUSTRIAL GAS SCHOOL—Industrial gas school of the American Gas Association, Penn-Sheraton Hotel, Pittsburgh, Pa. Ralbern H. Murray, American Gas Association, 420 Lexington Ave., New York 17, N. Y. ..... **SEPTEMBER 14-18, 1959.**

ISA INSTRUMENT-AUTOMATION EXHIBIT—14th annual Instrument-Automation Conference and Exhibit of the Instrument Society of America, at the International Amphitheatre, Chicago, Ill. H. S. Kindler, ISA, 313 Sixth Ave., Pittsburgh 22, Pa. ..... **SEPTEMBER 21-25, 1959.**

WELDING SOCIETY MEETING—Fall meeting of the American Welding Society, at the Sheraton-Cadillac Hotel, Detroit, Mich. A. L. Phillips, American Welding Society, 33 W. 39th St., New York 18, N. Y. ..... **SEPTEMBER 28-OCTOBER 1, 1959.**

AGA CONVENTION—Annual convention of the American Gas Association, at the Conrad-Hilton Hotel, Chicago, Ill. C. S. Stackpole, managing director of the Association, 420 Lexington Ave., New York 17, N. Y. ..... **OCTOBER 5-7, 1959.**

ASA CONFERENCE—10th National conference on Standards, at the Sheraton-Cadillac Hotel, Detroit, Mich. Secretary of the Association, 70 E. 45th St., New York 17, N. Y. ..... **OCTOBER 20-22, 1959.**

ARI EXPOSITION—11th Exposition of the Air-Conditioning and Refrigeration Industry at Convention Hall, Atlantic City, N. J. Geo. S. Jones, Jr., managing director of Air-Conditioning and Refrigeration Institute, 1346 Connecticut Ave., N. W., Washington 6, D. C. ..... **NOVEMBER 2-5, 1959.**

HOTEL EXPOSITION—National Hotel Exposition New York Coliseum, New York, N. Y. ..... **NOVEMBER 2-6, 1959.**

CONTROL CONFERENCE—National Automatic Control Conference, sponsored by ASME, IRE, AIEE, ISA, Sheraton Hotel, Dallas, Tex. ASME Secretary, O. B. Schier, II, 29 W. 39th St., New York 18, N. Y. ..... **NOVEMBER 4-6, 1959.**

COMMERCIAL KITCHEN PLANNING—Seminar on commercial kitchen planning at Michigan State University, East Lansing, Mich. Ralbern H. Murray, American Gas Association, 420 Lexington Ave., New York 17, N. Y. ..... **NOVEMBER 9-13, 1959.**

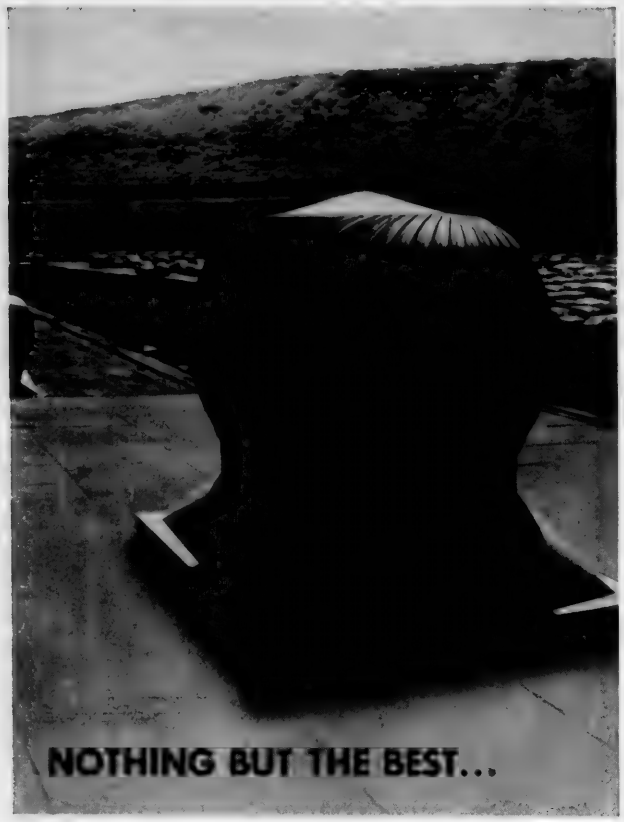
ASME ANNUAL MEETING—Annual meeting of the American Society of Mechanical Engineers, Chalfonte-Haddon Hall, Atlantic City, N. J. Secretary, O. B. Schier, II, 29 W. 39th St., New York 18, N. Y. ..... **NOVEMBER 29-DECEMBER 4, 1959.**

WARM AIR HEATING CONVENTION—Annual convention of the National Warm Air Heating and Air Conditioning Association, at the Chase Hotel, St. Louis, Mo. G. Boeddener, managing director of the Association, 640 Engineers Bldg., Cleveland 14, Ohio. ..... **DECEMBER 1-4, 1959.**

ASHRAE MEETING—Semi-annual meeting of the American Society of Heating, Refrigerating and Air-Conditioning Engineers, and the 2nd Southwest Heating and Air-Conditioning Exposition, sponsored by ASHRAE, in Dallas, Tex. The meeting will be at the Baker and Adolphus Hotels, and the Exposition in the Memorial Auditorium. Secretary of the Society, 62 Worth St., New York 13, N. Y. ..... **FEBRUARY 1-4, 1960.**

GAMA MEETING—Annual Meeting of the Gas Appliance Manufacturers Association, at The Greenbrier, White Sulphur Springs, West Va. H. Leigh Whitelaw, managing director of the Association, 60 E. 42nd St., New York, N. Y. ..... **MARCH 30-APRIL 1, 1960.**

CONGRESS ON OCCUPATIONAL HEALTH—13th International Congress on Occupational Health, first to be held in the Western Hemisphere, at the Waldorf Astoria Hotel, New York City. Dr. Leo Wade, organizing committee, 15 W. 51st St., New York 19, N. Y. ..... **JULY 25-29, 1960.**



Western Rotary® Roof Ventilators

with Lifetime Guaranteed Bearings

- "Backward curved blower wheel" type mechanism assures high, constant exhaust capacity, no backdraft ever.
- Certified wind tunnel tests by non-commercial national institute.
- Unique factory lubricated sealed bearings are specially designed for positioning load, countering wind pressure, assuring stability.
- Lock-on rotor, yet removable without special tools.
- Exclusive Western corrugated vane increases rigidity.
- Low, functional type adds beauty.
- Baked enamel paint coating for beauty and long life.
- Aluminum, copper, or stainless steel construction available.

Other type ventilators include:

- Stationary
- Directional
- Continuous ridge
- Vertical exhaust
- Axial roof
- Unit ventilators

Immediate Delivery on all sizes

Complete Catalog in Sweets and Western States A-E-C

Write for catalog and name of nearest representative.

WESTERN ENGINEERING & Mfg. Co.

4108 Glencoe Avenue, Venice, California

Since 1921 . . . a reliable leader.

Simplifying Field Survey Data
How to make a survey — Sample survey form

Basic Design Data
Design coordination — Design data form

Plumbing Codes
Code variations — Interpretation — Revising a code — National plumbing code

Footing Drains Around Buildings
Installation — Cleanouts — Sand interceptors

Location and Construction of Dry Wells
Sizing — Construction — Location

How to Install Drainage Piping in Fill
Compacted soil — Fill — Piping support

Function of Drainage Basins
Rainfall disposal — Dry Wells — Drainage basins

Protection of Site Utility Lines
Project utilities — Underground dangers — Trenching

Sub-surface Water Conditions
Piping arrangement — Waterproofing — Sewage ejectors

Design and Construction of Manholes
Location — Shape — Materials

Water Supply for Construction Projects
Responsibility — Piping — Installation — Connections

Access Space for Plumbing Fixtures
Design data — Advantages — Clearances

Wet Columns in Multi-story Buildings
Water and waste facilities — Spacing — Arrangement

Fixture Roughing for Low Rent Housing Projects
Typical layout — Space requirement — Economy

Vent Stack Terminal
Roof penetration — Flashing — Protection

Preventing Sewage Backflow in Buildings
System separation — Piping — Valves

Sump Pump Installations
Basins — Special conditions — Code compliance

Importance of Cleanouts in Building
Kinds of cleanout — Storm water

How to Install Exterior Cleanouts
Ground settlement — Grass surfaces — Paved top

Flexible Arrangement of Rest Room Facilities
Old and new buildings — Fixture roughing

Providing Access for Building Traps
Shallow installations — Concrete pits — Backwater valves — Watertight installations

Service Hot Water for Schools
Determining needs — Generation equipment — Storage

External Indirect Water Heaters
Capacity — Operation — Circulation — Supply

Two-Temperature Service Hot Water
Methods — Generators — Dual installation

Economy in Service Hot Water Generation
Condensate coolers — Storage — Piping

Supports for Hot Water Storage Generators
Location — Clearances — Sizing — Suspension

Water Hammer Arrestors
Water hammer causes — Methods of control — Devices

Balancing Service Hot Water Systems
Circulation — Upfeed systems — Valving — Controls

Interception of Volatile Fluids
Floor drainage — Fire hazard — Multi-story installations

Expansion in Hot Water Piping Systems
Expansion rates — Devices — Hangers — Anchoring

Increasing Water Supply Pressure in Buildings
Street mains — Tankless, pneumatic and roof tank systems

Gas Service for Multi-story Buildings
Distribution — Main support — Expansion — Safety

First Aid Fire Protection
Occupancy — Standard and extra equipment

Fire Protection for Apartment Houses
Standpipe system — Piping — Water supply — Hose stations

Fire Protection in Tall Buildings
Standpipe systems — Siamese connection — Fire pumps — Hose stations — Roof manifold — Roof tank

Parking Area Drainage
Methods — Sump pumps — Dry wells — Basins

Storm Drainage System for Flat Roofs
Rainfall intensity — Types of drain — Flow — Connections — Piping

Water Service for Research Laboratories
Distribution piping — Supply separation — Hot water systems — Laboratory benches

Emergency Protection of Laboratory Personnel
Emergency devices — Showers — Location — Types

Drinking Water Systems
Fountains — Coolers — Roughing in — Central systems

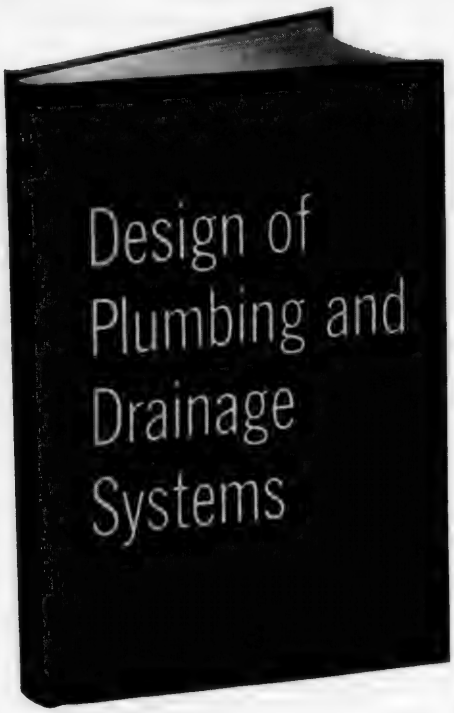
Distilled Water Systems
Distilling units — Storage tanks — Central systems

Fixtures for Mental Hospitals
Rest rooms — Lavatories — Water closets — Roughing in — Shower rooms — Private rooms

Plumbing Systems for Motels
Motel units — Arrangement — Access — Fixtures

Water and Drainage Facilities for Animal Quarters
Cage cleaning — Drainage — Waste systems

Draining the Planting Area
Interior areas — Roof areas — Exterior planting



ALL THIS INFORMATION ON MODERN PLUMBING PRACTICE AND DESIGN IN ONE BOOK!

Louis Blendermann, well-known authority, draws upon more than twenty years of plumbing design experience to present this encyclopedia coverage of modern plumbing practice and design.

If you are an engineer or contractor the profuse and detailed illustrations of specialized and modern installation techniques will be of value to you. DESIGN OF PLUMBING AND DRAINAGE SYSTEMS is also a detailed guide for the young designer and a complete reference manual for the experienced designer who meets a new and unusual problem.

To order, use coupon below or circle letter F on postcard, last page.

328 Pages
201 Illustrations

$7.00

Mail order from Canada and overseas, $8.50

THE INDUSTRIAL PRESS, 93 Worth Street, New York 13, N. Y.

Please send me ..... copies of Design of Plumbing and Drainage Systems.

☐ Check or money order is enclosed. Send book (s) postpaid.

☐ Send book (s) and invoice, including postage. I will pay within five days if I decide to keep the book (s). ☐ Bill me ☐ Bill company

Name .....

Company .....

Company Address .....

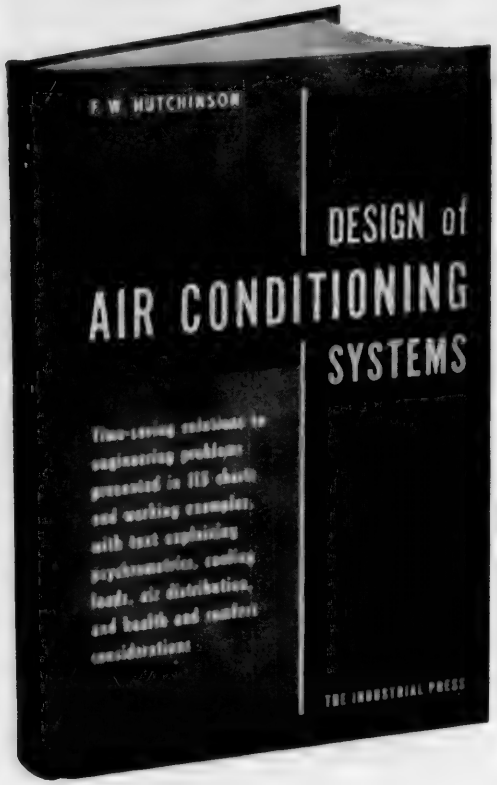
City ..... Zone ... State .....

Home Address .....

(Please fill in if you want book sent to your home)

ACHV/6/59

NOW YOU CAN SOLVE PROBLEMS OF AIR CONDITIONING SYSTEM DESIGN—QUICKLY!



GRAPHS.

12 GRAPHS RELATING TO PSYCHROMETRICS
For example: Temperature Gain of Air Passing Through an Adsorbent; Enthalpy of an Air Mixture

9 GRAPHS RELATING TO COOLING LOAD
For example: Overall Coefficient Corrections for Framing; Heat Transmission Rates for Low *U* Values.

18 GRAPHS RELATING TO SUMMER SOLAR EFFECT
For example: Roof Overhang Shading Factor: Latitudes 30° and 35°; Horizontal Surface: Latitudes 30° and 35°

25 GRAPHS RELATING TO COMFORT AND HEALTH
For example: Comfort, Discomfort, and Unhealthful Psychrometric Regions; Ventilation Requirements for Odor Control

19 GRAPHS RELATING TO SUPPLY STATE
For example: Supply State Determination for Ratios of Sensible Heat Load to Total Heat Load of from 0.0 to 10.0

5 GRAPHS RELATING TO DUCTS AND FITTINGS
For example: Friction Loss of Air in Straight Round Galvanized Ducts: Low Volume Range; Roughness Correction Factor for Duct Friction Losses

11 GRAPHS RELATING TO NOISE CONTROL
For example: Sound Pressure and Intensity as a Function of Noise Level; Sound Attentuation by Use of Acoustic Lining in Ducts

16 GRAPHS RELATING TO PANEL COOLING
For example: Load Carried by Cooling Panel; Panel Surface Temperature as a Function of Surface Area Cooled

Also by F. W. Hutchinson—
DESIGN OF HEATING AND VENTILATING SYSTEMS

Problems of heating and ventilating involving load determination, duct design, panel heating, solar heating and combustion analysis can be solved directly by means of the 96 full-page working charts which are the outstanding feature of DESIGN OF HEATING AND VENTILATING SYSTEMS, a companion book to DESIGN OF AIR CONDITIONING SYSTEMS.

The scales used in constructing these graphs have been selected so that their accuracy will equal or exceed the limits of accuracy of the equations from which they were derived.

GRAPHS LIKE THESE CAN SIMPLIFY YOUR WORK

2 Graphs Relating to Comfort
14 Graphs Relating to Heat Transmission
4 Graphs Relating to Ventilation and Humidification
6 Graphs Relating to Pipe, Tube and Duct Heat Losses
10 Graphs Relating to Fuels and Combustion
19 Graphs Relating to Air Distribution
3 Graphs Relating to Forced Circulation Warm Air Systems
14 Graphs Relating to Panel Heating Systems
21 Graphs Relating to Solar Heating

320 Pages **$7.00** 96 Charts

By mail, in Canada or overseas, $8.50

115 FULL-PAGE GRAPHS

Special Feature of A New Book by F. W. Hutchinson, Author of *Design of Heating and Ventilating Systems*

If you design air conditioning systems, naturally you want fast and accurate solutions to your problems. DESIGN OF AIR CONDITIONING SYSTEMS provides 115 full-page working charts that help you determine: cooling load, duct design, psychrometrics, solar energy, comfort conditioning, panel cooling and other phases of air conditioning design . . . DIRECTLY. In many cases use of the graphs will entirely eliminate calculation, while in others the graphs serve to minimize the arithmetical work needed in solving the equations.

Each chart is accompanied by a design problem and the solution illustrating the use of the method. Explanatory text in each chapter clearly explains the engineering background and the mathematical basis of each chart, but the book is so arranged that use of the chart is not dependent upon reading the text.

SPECIAL FEATURES

• A detailed presentation of data relative to determination of acceptable inside thermal levels for optimum comfort. The treatment (Chapter 5) includes means of correcting inside dry bulb temperature for such comfort effects as those due to work rates or occupants, relative humidity, air motion, and radiant transfer.

• A comprehensive chapter (Chapter 4) presenting complete data on solar irradiation rates on walls, roofs, and inclined surfaces, with consideration given to latitudes, monthly variation of sun's position, and hourly changes in irradiation rates.

• A group of 19 full-page, direct-reading graphical solutions (Chapter 6) to assist the user in determining the required supply point of conditioned air.

• A special chapter (Chapter 9) on the design of panel cooling systems to facilitate precise panel design for selected inside conditions with a minimum of required calculation.

The author is Professor of Mechanical Engineering at the University of California, and is co-author of a number of books on Panel Heating, Refrigeration and Air Conditioning. His knowledge of system design is well grounded on practical experience as well as theory, as he acts as consultant for many industrial firms.

Treatment of the subject matter is highly selective, rather than comprehensive. Stress is on method, technique and application; which complements the handbook type of data readily available in standard sources—and makes DESIGN OF AIR CONDITIONING SYSTEMS unique in its field.

336 Pages **$7.00** 118 Charts and Illustrations

Send for DESIGN OF AIR CONDITIONING SYSTEMS and DESIGN OF HEATING AND VENTILATING SYSTEMS today!
See special combination offer saving $1.50 in coupon below.

THE INDUSTRIAL PRESS, 93 Worth Street, New York 13, N. Y.

Please send me ☐ DESIGN OF AIR CONDITIONING SYSTEMS at $7.00
In Canada or overseas, $8.50
☐ DESIGN OF HEATING AND VENTILATING SYSTEMS at $7.00
In Canada or overseas, $8.50
☐ both at $12.50 In Canada or overseas, $15.00

Name .....
Firm .....
Street .....
City ..... Zone ..... State .....
Home Address .....
(Please fill in if you want book sent to your home) ACH&V 6/59

CHOOSE METHOD OF PAYMENT YOU PREFER

☐ Payment in full enclosed. Send book(s) postpaid. (Book(s) may be returned for full credit if you are not satisfied.)

☐ Send book(s) under Five-day Free Inspection Plan. (Postage and handling charges of 15c per book are added.)

☐ Bill me ☐ Bill Company

Note: Orders from overseas must be accompanied by payment in full in U. S. funds.

CLASSIFIED ADVERTISING

Sold at $12 per column inch.

WANTED
SALES REPRESENTATIVES (TWO)

Leading manufacturer of industrial ventilation equipment offers attractive proposition to qualified representatives in Des Moines and Omaha areas. Established, fast-moving organization. Excellent products lines backed by national advertising. Good commission set-up. Box 942, Air Conditioning, Heating & Ventilating, 93 Worth St., New York 13, N. Y.

MANUFACTURERS' AGENTS

An established manufacturer with 25 years experience producing ventilating equipment is looking for manufacturer's agents in many sections of the country to sell their new line of industrial fans. The products include axial flow and tubeaxial fans, both direct and belt driven, and power roof ventilators.
Please reply Box 914, Air Conditioning, Heating & Ventilating, 93 Worth St., New York 13, N. Y.

PRINTED FORMS available for immediate shipment. Heating & oil burner materials form, burner service record cards, service order forms, inspection information form, survey sheet and others. Also can supply BURNER SERVICE form in 8 part EZE-SNAP with 3 carbons in each set, 1200 sets Imprinted with your name, address and telephone, only $20.40. Send for samples—no obligation. Write Dept. AC, Degree Day Systems, 39-30 58th St., Woodside 77, N. Y.

TWO NEW BOOKS ON HOME AIR CONDITIONING

SUMMER AIR CONDITIONING by S. Konzo, J. R. Carroll and H. D. Bariether.

This basic what-how-and-why book on residential air conditioning is a training text and reference book for all who design, sell, install or operate air conditioning systems and equipment for houses and small buildings. Prepared at the request of the U. S. Armed Forces Institute, it contains problems and exercises for each chapter which help check the reader's understanding of the material.

All problems can be solved by the use of simple arithmetic. All industry methods, including those recommended by engineering and trade associations, have been taken into account. A psychrometric chart is provided. 560 pages, 266 illus., **$8.00.**

WINTER AIR CONDITIONING, a companion volume by the same authors.

Presents the why and how of controlled distribution of heat and humidity in small buildings and homes. Contains a wealth of working data such as heat loss factors for various walls, design temperatures for hundreds of U. S. and Canadian cities, degree-days and how to estimate fuel consumption, etc. WINTER AIR CONDITIONING gives dealers, contractors, installers and salesmen the full background they need to be sure each furnace or boiler, ducting or piping system is tailored to the needs of individual buildings.

Similar in format to SUMMER AIR CONDITIONING, each chapter contains problems, and answers are given in the appendix. 640 pages, 300 illus., **$8.00.** SET OF BOTH, $15.00.

TO ORDER USE SPECIAL CARD OPPOSITE BACK COVER.

ALPHABETICAL INDEX OF ADVERTISERS

A

A-J Manufacturing Co. ..... *
Aerofin Corp. 9
Aerovent Fan Co., Inc. ..... *
Air Conditioning & Refrigeration Institute 56
Air Devices, Inc. ..... *
Air Filter Corp. ..... *
Air-Maze Corp. 159
Airtemp Div., Chrysler Corp. 65
Alco Valve Co. ..... *
Allen-Bradley Co. 143
Allen Cooler & Ventilator, Inc. 154
Allied Chemical Corp., General Chemical Div. 13
Allin Manufacturing Co. ..... *
Allis-Chalmers Mfg. Co. 57
American Brass Co. 141
American Gas Association 36-37
American Machine and Metals, Inc. .. 55
American-Standard Industrial Div. ... 20-21
Ammerman Co., Inc. 152
Anemostat Corp. of America 26
Armstrong Machine Works 1
Arno Adhesive Tapes, Inc. ..... *

B

Babbitt Steam Specialty Co. ..... *
Barber-Colman Co. 149-151
Bell & Gossett Co. 35
Bethlehem Steel Co. 147
Binks Manufacturing Co. 148
Bridgeport Brass Co. 30
Bryan Steam Corp. ..... *
Buensod-Stacey, Inc. 23
Buffalo Forge Co. 53
Buffalo Pumps Div., Buffalo Forge Co. *
Burnham Corp. ..... *
Burt Manufacturing Co. 144
Byers, A. M., Co. ..... *

C

Cain Manufacturing Co. ..... *
Chase Brass & Copper Co. ..... *
Chicago Pump Co. 42-48
Clarage Fan Co. ..... Inside Back Cover
Classified Advertisements 164
Cleaver-Brooks Co., Boiler Div. 146
Construction Specialties, Inc. ..... *
Cook, Loren, Co. ..... *
Coyne & Delany Co. ..... *
Crane Packing Co. ..... *

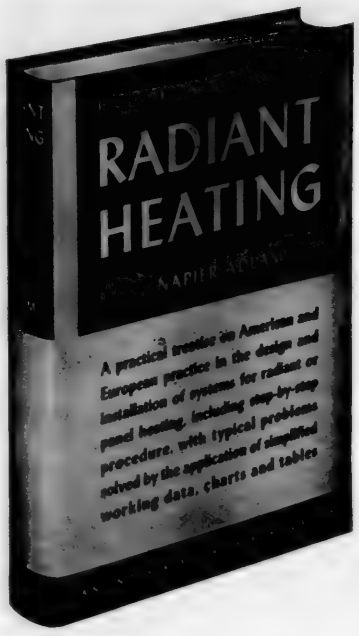
D

Davis Engineering Corp. ..... Insert 33-34
DeBothezat Fans Div., American Machine and Metals, Inc. 55
Dravo Corp. ..... *
Drayer-Hanson Div., National-U. S. Radiator Corp. ..... *
Dunham-Bush, Inc. 11
Dwyer, F. W., Manufacturing Co. ... 139

E

Edwards Engineering Corp. ..... *
Elgo Shutter & Mfg. Co. ..... *
Emerson Electric Mfg. Co. 60

Here is a Book That Gives You All the Answers!


RADIANT
HEATING
T. NAPIER ADLAM
A practical treatise on American and European practice in the design and installation of systems for radiant or panel heating, including step-by-step procedure, with typical problems solved by the application of simplified working data, charts and tables

What do you want to know about radiant heating? Here is a book that gives you the answers — the right answers—written by an outstanding authority on the subject, "Radiant Heating" by T. Napier Adlam, provides basic information plus working data necessary to design and install efficient systems . . . covers radiant heating with ceiling, wall and floor panels, using all types of fuels . . . shows step-by-step procedure in laying out systems, using simplified charts that give most of the essential data without calculation.

If you want authoritative answers to radiant heating questions, you'll find time-saving, money-saving solutions to your problems in this book. Send for your copy today!

504 pages $6.00 337 illustrations

By mail order from Canada or overseas, $7.25

Published by

THE INDUSTRIAL PRESS

93 Worth St.
New York 13, N. Y.

To order, circle letter R on postcard, last page.

ALPHABETICAL INDEX OF ADVERTISERS

F

F5 Air Conditioning Corp. 61
Fafnir Bearing Co. 31
Flexaust Co. 142
Frick Company 157

G

Governair Corp. 15
Greenheck Fan & Ventilator Corp. 157
Gustin-Bacon Manufacturing Co. 41

H

Halstead & Mitchell 51
Hansson, Elof, Inc. ..... *
Harris, Arthur & Co. 159
Hartzell Propeller Fan Co. 24
Henry Valve Co. ..... *
Hoffman Specialty Manufacturing Corp. 47
Hydrotherm, Inc. 166

I

Ilg Electric Ventilating Co. 5-7
Illinois Testing Laboratories, Inc. 132
Industrial Press 161-163
Inland Steel Co. 64
International Boiler Works Co. 165
Iron Fireman Manufacturing Co. 59

J

Jenkins Bros. 153
Jenn-Air Products Co., Inc. 131
Johns-Manville 54
Johnson Service Co. ..... Back Cover
Joy Manufacturing Co. 46

K

Kaiser, E. B., Co. 38

L

Lawler Automatic Controls, Inc. ..... *
Lennox Industries, Inc. 142

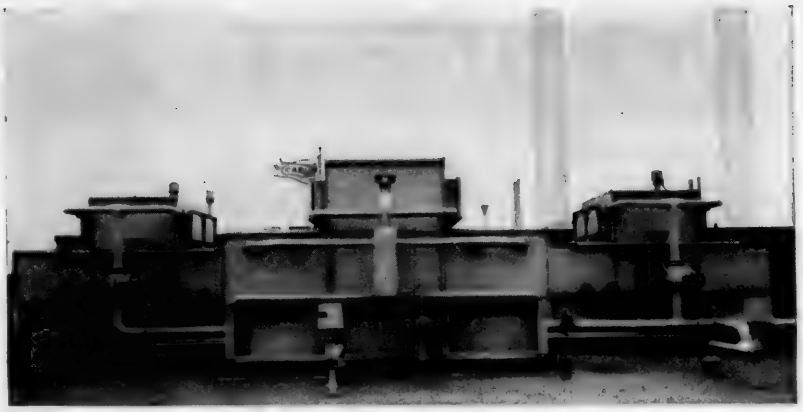
M

Magnetrol, Inc. ..... *
Marsh, Jas. P., Corp. 18
McDonnell & Miller, Inc. 39
McQuay, Inc. 44
Minneapolis-Honeywell Regulator Co. 134-137

N

Nash Engineering Co. 66
National Tube Div., United States Steel Corp. 52
New York Blower Co. ..... *
Niagara Blower Co. 165
Nibco, Inc. 48-49

(Continued on page 166)



GET TROUBLE-FREE CONDENSING AND GREAT POWER AND LABOR SAVINGS

NIAGARA AEROPASS CONDENSERS give you trouble-free, automatic refrigeration at the least spread between head-pressure and suction pressure. You gain a great power saving. You also get removal of superheat before condensing, condensing at subcooled temperature and a refrigerant fully purged of oil. Out-door air takes up heat of condensation through evaporation of the least amount of water; low temperature condensing means freedom from scaling and loss of capacity. Niagara sectional design offers you lower costs for more compact equipment, easier to keep up. You get always full capacity, "new plant" efficiency and continuous savings such as 95% of condensing water cost that add to your profit. Managers who know their costs buy Niagara Aeropass Condensers.

Write for Bulletin 131

NIAGARA BLOWER COMPANY

Dept. HV-6, 405 Lexington Ave., New York 17, N.Y.

Niagara District Engineers in Principal Cities of U. S. and Canada

MORE STEAM-FASTER AT LOWER COST

COMPAK water tube boilers are available as completely packaged forced draft units for low or high pressure service in 22 sizes from 12 to 750 HP.

Faster steaming is only one of the many superior features of INTERNATIONAL COMPAK WATER TUBE PACKAGE BOILERS.

No matter what you're looking for in a boiler — low cost . . . long life expectancy . . . high efficiency . . . low maintenance . . . easy cleaning . . . automatic, foolproof operation, etc. — it will pay you to take a closer look at the COMPAK.

Get full details from your INTERNATIONAL DISTRICT REPRESENTATIVE or write for Bulletin 1400 today.

IBW BOILER BUILDERS SINCE 1886

THE INTERNATIONAL BOILER WORKS CO.

890 Spruce St. East Stroudsburg, Pa.

Steel Firebox Heating & Power Boilers • Low & High Pressure Water Tube Package Boilers • International-LaMont Forced Recirculation Generators • ASME Code Pressure Vessels & Welded Products.

Manufactured and sold in Canada under agreement with CANADIAN VICKERS LTD. Montreal, P. Q.

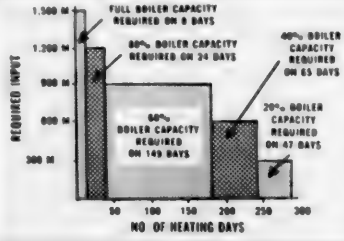
HYDROTHERM

PACKS
A 20%
GAS
SAVING
HERE
Here's where MultiTemp reduces gas costs by 20%. Return header has independent, differentially set aquastats that trigger each boiler, modulate input, and eliminate short cycling waste.

New MULTITEMP SYSTEMS
Make Gas Heat Competitive on "BIG JOBS"

Now even the big jobs requiring up to 3,600,000 BTU/hr input can enjoy the convenience and cleanliness of gas heat. A Hydrotherm MultiTemp system achieves true input modulation, brings gas consumption down and, being composed of multiple units, insures against service interruptions.

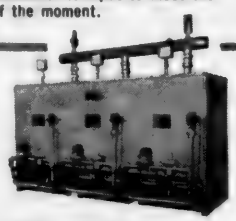
A MultiTemp battery of Hydrotherm boilers is hooked up with a separate aquastat for each boiler in the common return header. With each aquastat set for a different temperature, the boilers are fired or cut off independently. When the demand is small, only one boiler operates... when it is great or when the system is making a cold start, the complete heating plant is fired.



This graph shows the year-round load for a 1,500,000 BTU/hr hydronic plant in Bergen County, N. J., where degree days average 5600 to 6000. Heat was required for 293 days, but full capacity was needed for only 3% of that time.

Note how a single 1,500,000 BTU/hr boiler would have short cycled for 89% of the heating season at a great loss in efficiency. Note also how the MultiTemp battery of five 300,000 BTU/hr boilers modulated its input to meet the heating demand of the moment.

- *Input Ratings from 360,000 to 3,600,000 BTU/hr*
- *100 lbs. ASME Working Pressure*
- *Boilers Shipped Pre-Wired and Assembled*
- *Units Pass Thru 2'6" Doors*
- *Ideal for Volume Hot Water*



Write today for MultiTemp Catalog

HYDROTHERM INC

Dept. 13-AH, NORTHVALE, NEW JERSEY

OTHER FAMOUS HYDROTHERM PRODUCTS: HydroTherm • HydroVector • HydroChiller • HydroFin

ALPHABETICAL INDEX OF ADVERTISERS

(Continued from page 165)

P

Patterson-Kelley Co. 22
Peerless Electric Co. 62
Petro ..... *
Pittsburgh Plate Glass Co. 145
Powers Regulator Co. 25

Q

Quickdraft Corp. ..... *

R

Ray Burner Co. ..... *
Reading Tube Corp. 45
Revere Copper & Brass, Inc. 58
Reznor Manufacturing Co. 157
Ric-Wil, Inc. 133

S

Sarco Co., Inc. 63
Sarcotherm Controls, Inc. 63
Skidmore Corp. 2
Smith, A. O., Corp. ..... *
Smith, Jay, R., Mfg. Co. 138
Spence Engineering Co., Inc. 32
Sporlan Valve Co. 27
Spraying Systems Co. 155
Sterling, Inc. ..... *
Sturtevant Div., Westinghouse Electric Corp. ..... *
Symmons Engineering Co. 156

T

Thermal Engineering Corp. 158
Thermco Instrument Corp. ..... *
Trane Co. 28-29
Tuck-Aire Furnace Co. ..... *

U

United States Steel Corp., National Tube Div. 52

V

Vilter Manufacturing Co. 140

W

Wagner Electric Corp. ..... *
Waterloo Register Co., Inc. ..... *
Watts Regulator Co. ..... Inside Front Cover
Webster Electric Co. 155
Webster Engineering Co. ..... *
Weil-McLain Co. 40
Weil Pump Co. ..... *
Weirton Steel Co., Div., National Steel Corp. 17
Weksler Instruments Corp. ..... *
Western Engrg. & Mfg. Co. 160
Westinghouse Electric Corp., Sturtevant Div. ..... *
Wheeling Steel Corp. 19
Wiremold Co. 152

Y

Yarnall-Waring Co. 50
York Corp. ..... *

* Advertiser appeared in preceding issue

INQUIRY SERVICE FOR ADVERTISED PRODUCTS

Use this Digest to locate and refer to the advertisements in which you are particularly interested, then fill out and mail a prepaid multipurpose postcard, either of two that appear on the yellow page following, to request further information from manufacturers.

PRESSURE REGULATORS .....
for commercial, industrial and institutional application have been made by Watts Regulator Co. for over 82 years. Two folders are offered.
Inside Front Cover — Item 200

STEAM TRAPS .....
of the inverted bucket design, from Armstrong Machine Works, are designed and made to give these benefits: No steam loss, automatic air elimination, and no cooling leg required. Steam trap book is offered.
Page 1 — Item 201

TWO PUMPS .....
offering more capacity and more performance are available from Skidmore Corp. They are described in two bulletins which are available from the company.
Page 2 — Item 202

POWER ROOF VENTILATORS .....
and fans manufactured by Ilg assure silent service and vibration-free performance. 510 churches use this equipment. Four bulletins are offered.
Pages 5-7 — Item 203

WORLD'S LARGEST .....
completely air conditioned building, the Chase Manhattan Bank, is using Aerofin coils which permit ample heat exchange capacity in limited space. Information is available.
Page 9 — Item 204

VACUUM PUMP RECEIVER .....
warranty for a ten-year period is issued by Dunham-Bush to reaffirm continuance of quality product lines. Engineering specifications on receivers are available, as well as sample warranty.
Page 11 — Item 205

REFRIGERANT CYLINDER CARRIER ...
doubles as a charging stand. It is offered during July and August with the purchase of 22 lb or more of Genetron refrigerants. Information is available.
Page 13 — Item 206

"SATISFABRICATED" CONDITIONERS
are what Governair calls its 422 completely packaged air conditioners which are built to suit your requirements. Information is available.
Page 15 — Item 207

LOCK-SEAMING OPERATIONS .....
can give trouble; if they do, Weirton Steel Co. recommends switching to its zinc coated steel as other fabricators are doing. Booklet is available.
Page 17 — Item 208

DIAL THERMOMETERS .....
are offered in new and complete line by Jas. P. Marsh for piping and duct work. For use on heating and cooling equipment, air ducts, vessels, kilns, ovens, etc. Bulletin tells the whole story.
Page 18 — Item 209

GALVANIZED STEEL SHEETS .....
from Wheeling Steel Corp. will not flake or peel. Anything that can be made of steel sheets can be made of this product. Information is available.
Page 19 — Item 210

ONE-SOURCE RESPONSIBILITY .....
for quality and performance in equipment that is designed, engineered and manufactured to work together is provided by American Standard Industrial Division. Information on equipment is available.
Pages 20-21 — Item 211

HEATING EQUIPMENT FILE .....
composed of four catalogs provides installation and performance data that you will need when specifying any hot water system. File is available from Patterson-Kelley.
Page 22 — Item 212

AIR MIXING UNITS .....
with automatic volume regulators, from Buensod-Stacey, eliminate the bottleneck of on-the-job adjustment of volume in dual-duct high velocity installations. Information is available.
Page 23 — Item 213

EACH VENTILATION PROBLEM .....
must be carefully engineered to obtain satisfactory results. Hartzell Propeller Fan Co. takes pride in its engineers and ventilating equipment. Information is available.
Page 24 — Item 214

AIR CONDITIONING CONTROL .....
from The Powers Regulator Co. helps maintain ideal working climate and product quality in Stuart Co., award winning pharmaceutical plant in Pasadena, Calif. Information is available.
Page 25 — Item 215

PERFECT AIR DIFFUSION .....
for electronic computers is provided by Anemostat air diffusers. High heat return from equipment and lighting is efficiently controlled. Selection manual is offered.
Page 26 — Item 216

SOLENOID VALVES .....
from Sporlan Valve Co. provide peak performance for any installation, regardless of capacity, whether for refrigerants, water, steam or hot gas applications. Bulletin is offered.
Page 27 — Item 217

TRUE PERIMETER .....
air conditioning that meets today's needs for tenant changes, and does it economically, is available with Trane's "Wall-line" system. Information is offered.
Pages 28-29 — Item 218

Ad-Digest

Use this Digest to locate and refer to the advertisements in which you are particularly interested, then fill out and mail a prepaid multipurpose postcard, either of two that appear on the yellow page following, to request further information from manufacturers.

INQUIRY SERVICE FOR ADVERTISED PRODUCTS

COPPER TUBE .....
from Bridgeport Brass was used for the new Encina, California, high school. Contractor and distributor give reasons in ad. Information is available.
Page 30 Item 219

BALL BEARINGS SIMPLIFY DESIGN ...
and assembly for Frick Co. of fan shaft bearings for air cooling unit and evaporative condensers. Fafnir bearings provide positive protection against moisture. Information is available.
Page 31 Item 220

WHEN REGULATORS DEVELOP .....
trouble, engineers want to get them back on the line quickly. That's one reason why more engineers are standardizing on Spence regulating valves with externally mounted pilots. Bulletin is offered.
Page 32 Item 221

CIRCULATING PUMPS .....
from Bell & Gossett Co. are designed and built specifically to serve the exacting needs of circulated water heating and cooling systems. Outstanding characteristic is their quietness. Information is available.
Page 35 Item 222

GAS AIR CONDITIONING .....
from Ready-Power is providing exact climate control every day of the year for Washington, D. C., advertising agency. Information is offered.
Pages 36-37 Item 223

UNDERGROUND SYSTEMS .....
for heat distribution are a specialty of E. B. Kaiser Co. Hints on specifying Ebko piping systems are detailed in advertisement. A 24-page catalog for designing and specifying underground heat distribution systems is offered.
Page 38 Item 224

LOW WATER HAZARDS .....
in steam and hot water heating boilers call for positive control. McDonnell & Miller cut-off combinations are a simple, time proved answer. Information is available.
Page 39 Item 225

CAST IRON BOILER .....
manufactured by Weil-McLain Co. was selected in the restoration program for America's oldest synagogue. Bulletin is offered.
Page 40 Item 226

SNAP-ON INSULATION .....
for plant piping jobs affords better economy, performance, and thermal efficiency, according to manufacturer Gustin-Bacon. Information is available.
Page 41 Item 227

RELIABLE PUMPING .....
service for commercial, industrial and institutional buildings throughout the world has been provided since 1909 by Chicago pumps. Information is available.
Pages 42-43 Item 228

INDIVIDUAL ROOM CONDITIONERS ..
from McQuay, Inc., provide compact, modern styling, and require a minimum of installation space. They provide all-season comfort with quiet operation. Information is available.
Page 44 Item 229

COPPER TUBING LINE .....
available from Reading Tube includes: Lektroneal copper tube; Lektroseal copper refrigeration tube; Readi-Fin finned copper tube; and Mackenzie Walton precision copper tube. Also commercial copper tube, red brass and copper pipe. Information is available.
Page 45 Item 230

ADJUSTABLE BLADE FANS .....
from Joy Mfg. Co. are designed with integral motors to permit in-duct installation. Air volume calculations need not be precise with these units. Bulletin is offered.
Page 46 Item 231

STEAM SPECIALTIES .....
from Hoffman Specialty Mfg. Corp. are available in a complete quality line to give you better control of every requirement. Information is available.
Page 47 Item 232

COPPER FITTINGS .....
from Nibco Inc., permitted plumbing to be installed in a building that wasn't there. Prefabricated system saved space, time and money. Catalog is available.
Page 48 Item 233

WELDING FITTINGS .....
from Nibco conform in all respects to the high standards set forth by the American Society for Testing Materials. Catalog is offered.
Page 49 Item 234

PACKED EXPANSION JOINTS .....
produced by Yarnall-Waring guarantee continuous service. GunPakt joints never need repacking, are rugged, dependable, all-steel units. Many in service over 25 years with only nominal maintenance and no major repairs. Bulletin is offered.
Page 50 Item 235

THIN SPACING YOU WANT .....
is offered with Halstead & Mitchell's coils, which are suitable for use with most refrigerants, steam, hot or chilled water. Information is available.
Page 51 Item 236

STEEL PIPE .....
bearing USS National brand is providing 27,000 feet of heat at the U. S. Air Force Academy near Colorado Springs, Colo. Information is available.
Page 52 Item 237

FALLING TEMPERATURES .....
don't make much noise; neither do these fans from Buffalo Forge Co. Units available for high pressure and moderate pressure systems. Information is offered.
Page 53 Item 238

TRANSITE VENT PIPE .....
produced by Johns-Manville is made of asbestos-cement; retains its original, attractive appearance, and saves on upkeep because it resists the attack of most gases, mists, fumes, and dusts. Information is available.
Page 54 Item 239

DUCT-MOUNTED FANS .....
make fume removal an inside job. Space saving DeBothezat units provide efficient direct drive power. Information is available.
Page 55 Item 240

The items appear in the same order as the advertisements to which they refer, to facilitate obtaining further information after reading an advertisement. All advertisements are digested here except those that are received too late for inclusion in this listing.

Ad-Digest

INQUIRY SERVICE FOR ADVERTISED PRODUCTS

ARI SEAL BOOKLET .....
explains Seal of Certification program of Air-conditioning and Refrigeration Institute for unitary air conditioning equipment, your guarantee that the unit's rated capacity is in accordance with ARI Standards. A directory of manufacturers participating in the program is included.
Page 56 Item 241

LOW VOLTAGE MOTOR CONTROL ...
line from Allis-Chalmers provides wide open accessibility for fast and easy installation, modification, inspection and maintenance. Details are available.
Page 57 Item 242

STORAGE WATER HEATER .....
showed no sign of wear or corrosion after 26 years of operation. Credit Revere copper lining for this outstanding performance. Information is available.
Page 58 Item 243

COMPLETE FIRING SYSTEM .....
from Iron Fireman provides steam for Mutual Benefit Life's new buildings in Newark, N. J. Dual-fuel models can switch fuels instantly. Information is available.
Page 59 Item 244

CUSTOM-ENGINEERED MOTORS .....
are produced by Emerson-Electric to suit your specific needs. They provide the kind of timing that pays off in the profit column. Information is available.
Page 60 Item 245

AIR COOLED CONDENSERS .....
from f5 Air Conditioning Corporation are better due to greater capacity, more economy, greater fin surface efficiency and less power required. Information is offered.
Page 61 Item 246

FAN AND BLOWER PRODUCTS .....
at Peerless Electric Co. are electronically tested and checked for balance under actual operating speeds as a final inspection step. Catalogs are available.
Page 62 Item 247

THE ZINC COATING .....
of Inland Steel's galvanized sheet could not even be flaked by Slammin' Sam Snead. Information is available.
Page 64 Item 248

PACKAGED AIR CONDITIONERS .....
from Chrysler Corp. incorporate standard "extras" that your clients would pay $364 to get separately. Specifications and technical information are offered.
Page 65 Item 249

ALUMINUM POWER EXHAUSTERS ....
from Jenn-Air are available for roof and wall installation. They feature stainless steel U-spring noise and vibration isolators, which are guaranteed for life. Bulletin is offered.
Page 131 Item 250

DIRECT READING VELOMETER .....
measures actual air delivery. Simple, direct reading gives instant measurement in any distribution system. Ainor velometer is portable, easy to understand and to use. Bulletin is available.
Page 132 Item 251

UNDERGROUND PIPING .....
from Ric-wiL will handle the steam service for the extension of the Capitol building in Washington, D. C. Literature is available.
Page 133 Item 252

PNEUMATIC CONTROL SYSTEM .....
for high velocity double duct applications is available from Minneapolis-Honeywell. Complete coordination results in better temperature control and lower operating costs. Information is available.
Insert bet. 134-138 Item 253

CENTRALIZED CONTROL SYSTEM ....
from Minneapolis-Honeywell features modular building block design which offers greater economy and new flexibility. It lets one man do the work of a crew. Information is available.
Insert bet. 134-138 Item 254

HYDROSTATIC SHOCK CONTROL ....
produced by Jay R. Smith, controls water pressure with pneumatic pressure. Provides a more effective and efficient way to control hydrostatic shock and eliminate water hammer in any hot or cold water piping system. Booklet is available.
Page 138 Item 255

INSTRUMENT MANUAL .....
from Dwyer offers new gages and new ideas. Company's complete line is shown. Send for yours.
Page 139 Item 256

AIR CONDITIONING SYSTEM .....
at Doctors Motel, St. Petersburg, Fla., has not required a single adjustment since December, 1956. Owners are sold on the Vilter system. Bulletin is offered.
Page 140 Item 257

COPPER TUBE AND FITTINGS .....
assemblies from American Brass Co. are compact, and result in greater ceiling height and more usable floor area. Wide plumbing walls are not required. Information is available.
Page 141 Item 258

INDUSTRIAL HEATER .....
from Lennox Industries, Inc. is called super-quiet. Blower moves huge volumes of air at extremely quiet sound levels. Engineering data are offered.
Page 142 Item 259

FLEXIBLE HOSE .....
from The Flexaust Co. is adaptable for all kinds of fume and dust control and ventilation uses. It is durable, lightweight, and easy to install. Details are available.
Page 142 Item 260

MOTOR CONTROL .....
from Allen-Bradley was used by Trane Co. in its new engineering building. Trouble-free operations are assured due to simplicity of design. Information is available.
Page 143 Item 261

VITAL VENTILATING EQUIPMENT ....
is how Burt wall louvers are described. Line is complete from general purpose to industrial types. Data book is offered.
Page 144 Item 262

Ad-Digest

INQUIRY SERVICE FOR ADVERTISED PRODUCTS

Use this Digest to locate and refer to the advertisements in which you are particularly interested, then fill out and mail a prepaid multipurpose postcard, either of two that appear on the yellow page following, for further information from manufacturers.

FIBER GLASS INSULATION .....
from Pittsburgh Plate Glass Co. is great for insulating against heat, cold or noise. Three tests prove its strength. Information is available.
Page 145 Item 263

COMPACT PACKAGED BOILERS .....
from Cleaver-Brooks have a low headroom which simplifies installation in tight quarters. An example is at Peerless Automatic Machine Co. Information is available.
Page 146 Item 264

COOLING TOWER DESIGN .....
makes maintenance easy at Bornhoff Dairy, Glenview, Ill. Binks tower also does an efficient job under all weather conditions. Bulletin is offered.
Page 148 Item 265

UNIT VENTILATOR CONTROL .....
systems from Barber-Colman have all elements, including the thermostat, mounted within the unit ventilator enclosure. This provides greater control accuracy. Two booklets are offered.
Page 149 Item 266

CONSTANT VOLUME REGULATORS ..
from Barber-Colman offer these advantages in high velocity air transmission: Greater design flexibility, stable air delivery, and self-balancing operation of branch ducts. Catalog is available.
Pages 150-151 Item 267

CENTRIFUGAL ROOF EXHAUSTERS ...
of lowest silhouette design by Ammerman enhance the beauty of building skylines. Forward or backward curved wheels within or out of scroll housing. Certified cfm ratings. Bulletin is available.
Page 152 Item 268

FLEXIBLE AIR DUCT .....
from The Wiremold Co. is made with a flat metal spiral that mechanically locks to the fabric component. Two lengths join simply by screwing. Information is available.
Page 152 Item 269

VALVES FOR PLUMBING .....
and sprinkler systems of Chicago's tallest office building, the Prudential Insurance Company of America, were supplied by Jenkins Bros. Information is available.
Page 153 Item 270

TWO ROOF VENTILATORS .....
from Allen Cooler & Ventilator Co. are widely used for the engineered ventilation of modern structures, including industrial uses. Catalog and specifications are offered.
Page 154 Item 271

FUEL OIL HANDLING .....
equipment from Webster Electric provides a complete line for all commercial and industrial applications from tank to burner. Three bulletins are offered.
Page 155 Item 272

SPRAY NOZZLES .....
for evaporative roof cooling are manufactured by Spraying Systems Co. They reduce indoor temperatures on hot sunny days from 10 to 20 degrees. Bulletin is offered.
Page 155 Item 273

NON-SCALD SHOWER VALVE .....
from Symmons Engineering Co. is called America's favorite. Self-cleaning action prevents clogging and saves water. Literature is available.
Page 156 Item 274

SHELL VESSELS .....
from Frick Co. can be provided to fill all your needs. Company has 106 years' experience in building pressure vessels from boilers to reactors. Information is available.
Page 157 Item 275

AIR MOVEMENT DEVICES .....
from Greenheck Fan & Ventilator Corp. incorporate the highest quality materials and workmanship at the lowest possible price. Catalog is offered.
Page 157 Item 276

GAS UNIT HEATERS .....
can be specified with confidence because Reznor is prepared to deliver them when they are needed. Substantial stocks of both unit heaters and duct furnaces are maintained by distributors in over 200 cities. Booklet is offered.
Page 157 Item 277

AIR CONDITIONING SYSTEM .....
modernization at the Plaza Hotel in Houston called for Thermal multi-zone units. Detailed catalog is available.
Page 158 Item 278

WASHABLE AIR FILTER .....
developed by Air-Maze uses no oil, is completely dry, and yet can be washed clean in cold water. Bulletin describes this filter.
Page 159 Item 279

STAINLESS STEEL FLOATS .....
from Arthur Harris & Co. are designed for high pressure, high temperature, and corrosion resistance. Catalog describes them.
Page 159 Item 280

ROTARY ROOF VENTILATORS .....
from Western Engineering & Mfg. Co. have lifetime guaranteed bearings. High, constant exhaust capacity is assured. Catalog is available.
Page 160 Item 281

WATER TUBE PACKAGE BOILERS ....
from the International Boiler Works Co. provide more steam — faster and at lower cost. Bulletin is offered.
Page 165 Item 282

TROUBLE-FREE CONDENSING .....
and great power and labor savings are provided by the design of condensers from Niagara Blower Co. Bulletin is available.
Page 165 Item 283

BIG GAS HEAT UNITS .....
offered by Hydrotherm, Inc., enable the "big jobs," requiring up to 3.6 million Btu, to enjoy the convenience and cleanliness of gas heat. MultiTemp system achieves true input modulation, limits gas consumption. Catalog is available.
Page 166 Item 284

HEAVY-DUTY FAN .....
featuring a perfected airfoil blade design presents new highs in quietness and efficiency. Clarage Fan Co. describes this fan in a new catalog, which is offered.
Inside Back Cover Item 285

PISTON TYPE DAMPER OPERATORS ..
from Johnson Service Co. assure maximum power for accurate control of dampers. They have simple, trouble free construction. Three bulletins are offered.
Back Cover Item 286

CIRCLE FOR NEW EQUIPMENT AND LITERATURE INQUIRIES

CIRCLE FOR AD-DIGST INQUIRIES

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44
45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66
67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88
89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110

200	201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	220	221
222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240	241	242	243
244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265
266	267	268	269	270	271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287
288	289	290	291	292	293	294	295	296	297	298	299	300	301	302	303	304	305	306	307	308	309

PLEASE PRINT CLEARLY

Name .....

Title or Job Function .....

Firm .....

Nature of Firm's Business .....

Street .....

City .....Zone ....State .....

TO ORDER BOOKS DESCRIBED BELOW

Please send and bill me for the books circled: June '59

A B C D E F G H I J K L M N O P Q R S T U V

This service is not available to overseas readers. Cards are void after September 1, 1959.

FIRST CLASS
PERMIT NO. 53
NEW YORK, N. Y.

BUSINESS REPLY MAIL
NO POSTAGE NECESSARY IF MAILED IN UNITED STATES

POSTAGE WILL BE PAID BY

AIR CONDITIONING, HEATING and VENTILATING
93 WORTH STREET
NEW YORK 13, N.Y.

READERS SERVICE DEPT.

BOOKS TO HELP YOU WITH YOUR DESIGN PROBLEMS

DESIGN OF AIR CONDITIONING SYSTEMS

by F. W. Hutchinson

115 full-page charts solve problems of air conditioning system design involving cooling load, duct design, psychrometrics, solar energy, comfort conditioning, panel cooling, etc. For each chart the engineering and mathematical background plus design example and solution are given. **336 Pages, 118 Illus., $7.00.**

By mail from Canada or overseas, $8.50.

TO ORDER CIRCLE **B** ON CARD ABOVE

DESIGN OF HEATING AND VENTILATING SYSTEMS by F. W. Hutchinson

96 full-page charts solve problems of heating and ventilating involving load determination, duct design, panel heating, solar heating and combustion analysis. Companion book to Design of Air Conditioning Systems. Same methods to explain and solve problems are used. **320 Pages, 96 Charts, $7.00.**

By mail from Canada or overseas, $8.50.

TO ORDER CIRCLE **C** ON CARD ABOVE

COMBINATION OFFER

Both of the above books by Prof. F. W. Hutchinson, $12.50. By mail from Canada or overseas, $15.00

TO ORDER CIRCLE **D** ON CARD ABOVE

IT'S EASY TO GET THE BOOKS YOU NEED

Just circle the appropriate letters on one of the cards above and drop it in the mail. We'll ship the books and bill you. Or you can save 15c per book postage if you send payment with your order. Either way, you have full return privileges if not satisfied.

HANDBOOK OF AIR CONDITIONING, HEATING AND VENTILATING

Edited by Clifford Strock

Completely new book containing thousands of facts, figures, data and principles; hundreds of charts, tables and maps. Answers problems you face every day in your work. Subjects treated thoroughly include: Air Conditioning, Air Handling, Building Heat Loss, Climatic Data, Combustion, Degree-Days, Dual Duct Design, Dust Collection, Fuel Estimating, High Velocity Air, Mathematics, Motors, Piping and Plumbing, Psychrometry, Radiator, Heating, Refrigerants, Service Hot Water, Solar Data, Steam Flow, Ventilation, Warm Air Heating, Terminology and a complete cross index. 1094 Pages, 7¾" x 10¾", 598 Charts, Maps, Illus., 518 Tables, $15.00. By mail order, Canada and overseas, $17.00.

TO ORDER CIRCLE **L** ON CARD ABOVE

SUMMER AIR CONDITIONING

by S. Konzo, J. R. Carroll and H. D. Bareither

Training text and reference book on residential air conditioning for all who design, sell, install or operate these systems. Diagrams show mechanisms and principles of operation. Information understandable to beginner. Tells *how* and *why* things are done the way they are and *what* makes equipment operate the way it does. **560 Pages, 266 Illus., $8.00.**

By mail from Canada or overseas, $9.50.

TO ORDER CIRCLE **T** ON CARD ABOVE

WINTER AIR CONDITIONING

by S. Konzo, J. R. Carroll and H. D. Bareither

Does for heating what *Summer Air Conditioning* does for cooling. **$8.00.** SET OF BOTH, **$15.00.**

By mail, Canada or overseas, $9.50.

TO ORDER CIRCLE **U** ON CARD ABOVE

COMBINATION OFFER

Both of the above Air Conditioning books, $15.00. By mail from Canada or overseas, $18.00

TO ORDER CIRCLE **V** ON CARD ABOVE

MORE BOOKS LISTED ON OTHER SIDE →

FIRST CLASS
PERMIT NO. 53
NEW YORK, N. Y.

This service is not available to overseas readers. Cards are void after September 1, 1959.

BUSINESS REPLY MAIL
NO POSTAGE NECESSARY IF MAILED IN UNITED STATES

POSTAGE WILL BE PAID BY

AIR CONDITIONING, HEATING and VENTILATING
93 WORTH STREET
NEW YORK 13, N.Y.

READERS SERVICE DEPT.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44
45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66
67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88
89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110
200	201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	220	221
222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240	241	242	243
244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265
266	267	268	269	270	271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287
288	289	290	291	292	293	294	295	296	297	298	299	300	301	302	303	304	305	306	307	308	309

CIRCLE FOR NEW EQUIPMENT AND LITERATURE INQUIRIES

CIRCLE FOR AD-DIGEST INQUIRIES

PLEASE PRINT CLEARLY

Name .....

Title or Job Function .....

Firm .....

Nature of Firm's Business .....

Street .....

City .....Zone ....State .....

Please send and bill me for the books circled: June '59

A B C D E F G H I J K L M N O P Q R S T U V

TO ORDER BOOKS DESCRIBED BELOW

USE CONVENIENT CARD ABOVE TO ORDER THESE BOOKS

HIGH TEMPERATURE WATER SYSTEMS
by Owen S. Lieberg

A complete and concise exposition of the principles, design, installation and application of high temperature water. Written by the designer of many of the world's largest systems. For engineers, operators, and owners. **224 Pages, 109 Illus. $6.50.**

By mail from Canada or overseas, $7.75.

TO ORDER CIRCLE **M** ON CARD ABOVE

METHODS OF JOINING PIPE by J. E. York

The most detailed information available on standards and special joints for all types of metallic, glass, tile, plastic and concrete pipe. Data on joints designed to take up movement due to expansion and contraction. **236 Pages, 249 Illus., $4.00.**

By mail from Canada or overseas, $4.75.

TO ORDER CIRCLE **O** ON CARD ABOVE

EXHAUST HOODS by J. M. DallaValle

Practical hood design; latest principles of air handling, contaminant dilution and transport velocities; design of hoods for control of dust, mist, fumes, vapors, gases. Simple formulas and diagrams show exact procedures. **130 Pages, 127 Illus., $4.00.**

By mail from Canada or overseas, $4.75.

TO ORDER CIRCLE **H** ON CARD ABOVE

DESIGN OF PLUMBING AND DRAINAGE SYSTEMS by L. Blondermann

Detailed, illustrated guide covering modern plumbing practice and design. Basic problems as well as modern specialized topics are discussed. **328 Pages, 201 Illus., $7.00.**

By mail from Canada or overseas, $8.40.

TO ORDER CIRCLE **F** ON CARD ABOVE

FLUID FLOW IN PIPES by C. H. McClain

How to solve problems involving the flow of liquids and gases through pipes. How to handle viscosity, friction, heat, and other factors expressed in various dimensional systems. Worked-out problems show applications of principles. **124 Pages, 18 Illus., $4.00.**

By mail from Canada or overseas, $4.75.

TO ORDER CIRCLE **J** ON CARD ABOVE

PLANT AND PROCESS VENTILATION
by W. C. L. Hemeon

Design factors and data that can be applied to any situation. Principles are clear, logical. Shows how to estimate exhaust characteristics of any cold, multi-directional process; and obtain exhaust requirements for such a situation. **448 Pages, 172 Illus., $9.00.**

By mail from Canada or overseas, $10.75.

TO ORDER CIRCLE **Q** ON CARD ABOVE

INDUSTRIAL HEAT TRANSFER
by F. W. Hutchinson

Provides 123 time-saving working graphs for the direct solution of most commonly encountered problems. Graphs are equal in accuracy to the equations from which they are derived and help eliminate errors in calculation. **336 Pages, 136 Charts and Illus., $7.00.**

By mail from Canada or overseas, $8.50.

TO ORDER CIRCLE **N** ON CARD ABOVE

SNOW MELTING by T. Napier Adlam

Correct, tested steps in planning, designing, building and operating snow melting systems. Time saving charts, tables and graphs give data and simplify every step. **224 Pages, 189 Illus., $4.50.**

By mail from Canada or overseas, $5.50.

TO ORDER CIRCLE **S** ON CARD ABOVE

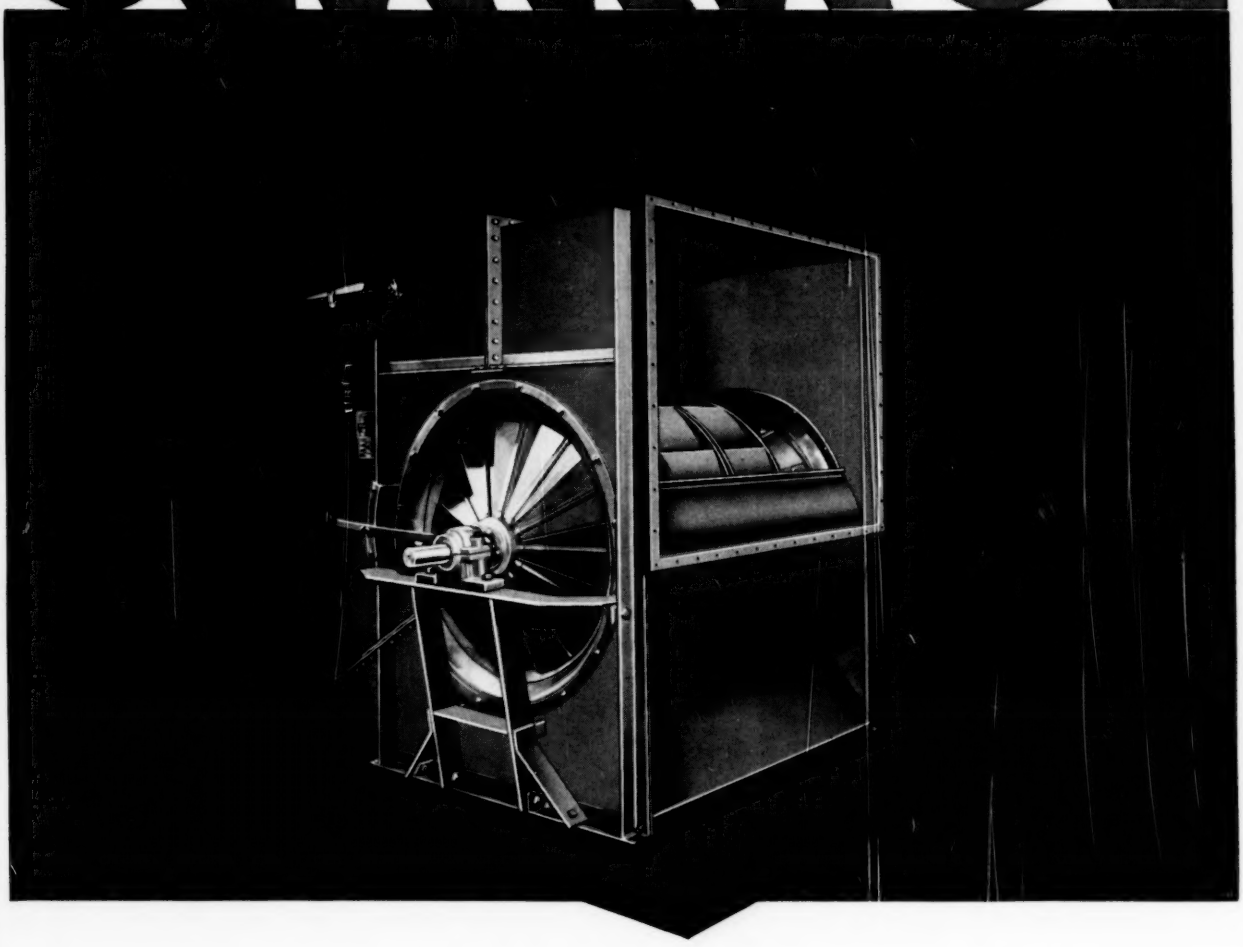
FLOW AND FAN by C. H. Berry

Covers the *flow* of gas through ducts, and *fan* performance and control; moving air through ducts, fan selection and control, duct arrangement, system characteristics, flow analysis. Basic data and methods used to calculate system resistance. Practical information for selecting a fan for any duty. **232 Pages, 84 Illus., $4.00.**

By mail from Canada or overseas, $4.75.

TO ORDER CIRCLE **I** ON CARD ABOVE

CLARAGE



NEW DYNAFOIL heavy-duty FAN

featuring a perfected airfoil blade design

With this new Clarage Type AF Dynafoil Fan you get stable high efficiency where it counts—under actual operating conditions.

Ideally suited to mechanical draft and heavy-duty applications, such as industrial processes, conduit type air conditioning, and tunnel ventilation, this latest in the Clarage line of superior fan equipment is built in 13 sizes, Classes II, III, and IV construction.

WRITE FOR CATALOG 859 which provides outlined dimensions and description of new Clarage Type AF Dynafoil Fans. Or contact nearest office.

Dependable equipment for making air your servant

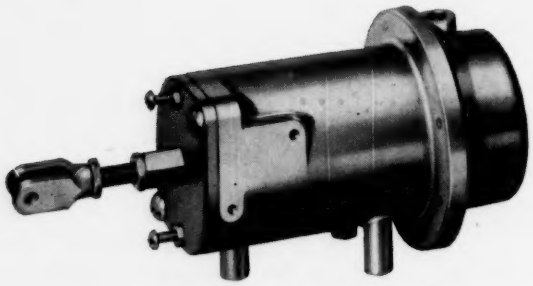
CLARAGE FAN COMPANY

Kalamazoo, Michigan

SALES ENGINEERING OFFICES IN ALL PRINCIPAL CITIES • IN CANADA: Canada Fans, Ltd., 4285 Richelieu St., Montreal

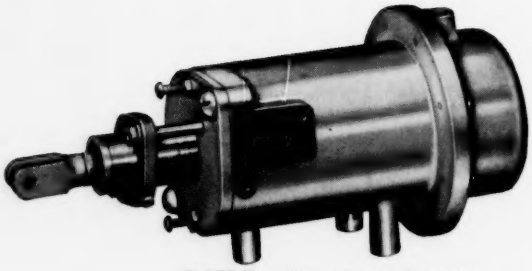
JOHNSON PISTON-TYPE DAMPER OPERATORS

ASSURE MAXIMUM POWER FOR ACCURATE CONTROL OF DAMPERS



D-251 Piston Damper Operator

- Powerful, long-stroke design. Allows damper to be operated *directly* from piston rod for accurate, positive positioning. No linkage or levers to lessen power. Outperforms conventional operators.
- Simple, trouble-free construction. Spring and diaphragm are fully enclosed. Powered by molded rubber diaphragms which are age- and heat-resistant.
- Adjustable stops permit limiting stroke in either direction.
- May be mounted in any position on damper frame, wall, or duct.
- Attractive die-cast, non-corrosive body.
- Size Nos. 2, 3, 4, and 6.

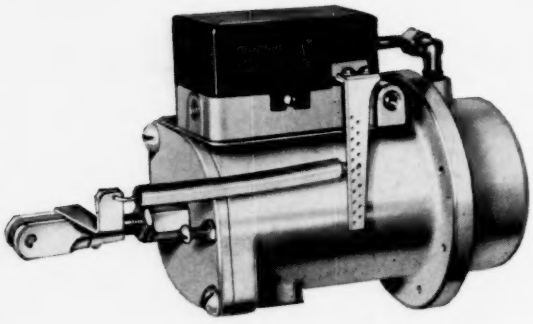


D-255 Two-Stage Piston Operator

Designed especially for unit ventilator applications, the D-255 two-stage operator has the same general features as D-251 plus:

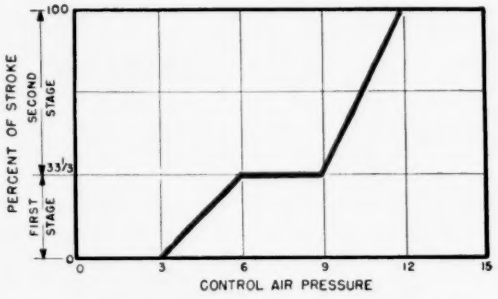
- Two-stage operation (see chart below). First stage is adjustable 0 to 50 per cent of total stroke.
- Compact, fits all unit ventilators. No. 3 size only.
- Choice of molded rubber or molded silicone diaphragms. Heat- and age-resistant.
- Self-lubricating Nylon insert stem guide.

For full details on the Johnson equipment shown here, write for Bulletins D-251, D-255 and D-265. Johnson Service Company, Milwaukee 1, Wisconsin.



D-265 Pilot Positioner Applied to D-251 Piston Damper Operator

The D-265 Pilot Positioner provides maximum and accurate repositioning power in response to very small changes in pressure from the controlling instrument. Assures proper operation independent of friction, changes in air velocities, or other variables. May be applied to all sizes of D-251 operators.



Relationship between stroke and control air pressure of D-255 Two-Stage Piston Operator.

JOHNSON CONTROL

PNEUMATIC SYSTEMS

DESIGN • MANUFACTURE • INSTALLATION • SINCE 1885